Computable Care Guidelines (CCGs)

What are they… **how** do they work… and **why** should we care?

Derek Ritz, P.Eng., CPHIMS-CA

HINF 597 – July 2, 2024

Mandatory apologies…

Sponsored by

IHE CATALYST

Computable Care Guidelines (CCGs)

Updating the progress of a long-running **HL7-IHE Gemini Project** to operationalize care guideline-adherence ***at scale***.

Derek Ritz, P.Eng., CPHIMS-CA

June 3, 2024

Story arc…

- *Super-brief* ***introduction***
- ***What*** are CCGs, and ***why*** do we need them?
- ***Who*** has made progress… and ***what*** can we learn?
- ***Where*** are we now, with the **IHE CCG** Profile?
- Q&A

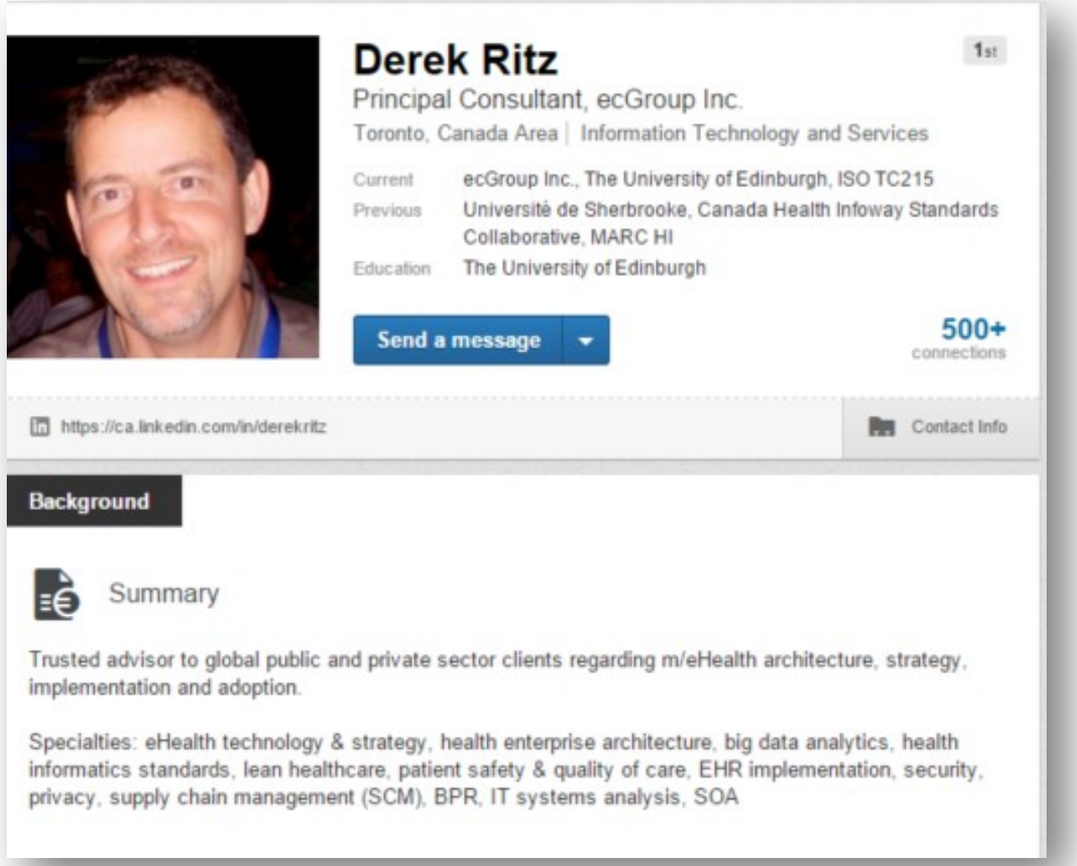
Story arc…

- *Super-brief* ***introduction***
- ***What*** are CCGs, and ***why*** do we need them?
- ***Who*** has made progress… and ***what*** can we learn?
- ***Where*** are we now, with the **IHE CCG** Profile?
- Q&A

…and how do they work?

CCG

LinkedIn



OpenHIE

World Health Organization

unicef

UNOPS

Joint Learning Network
For Universal Health Coverage

The World Bank

ADB

Canada Health Infoway

Inforoute Santé du Canada

ISO

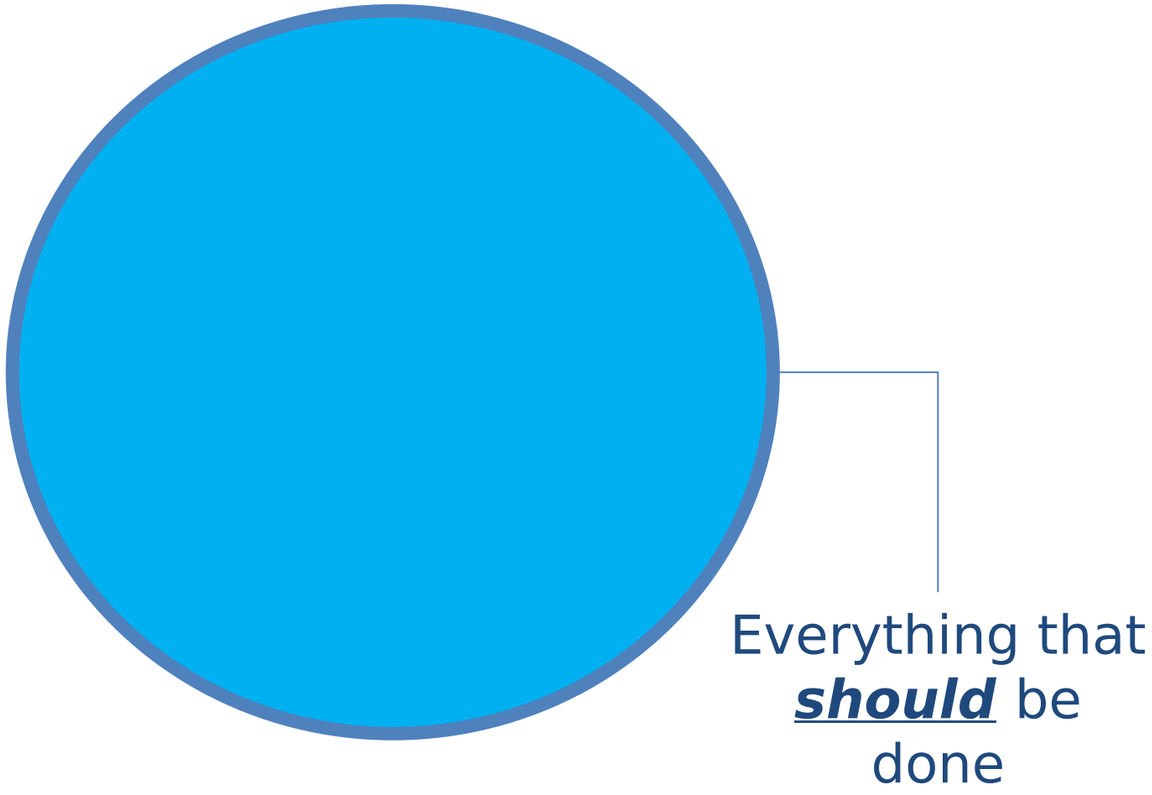
HL7

IHE

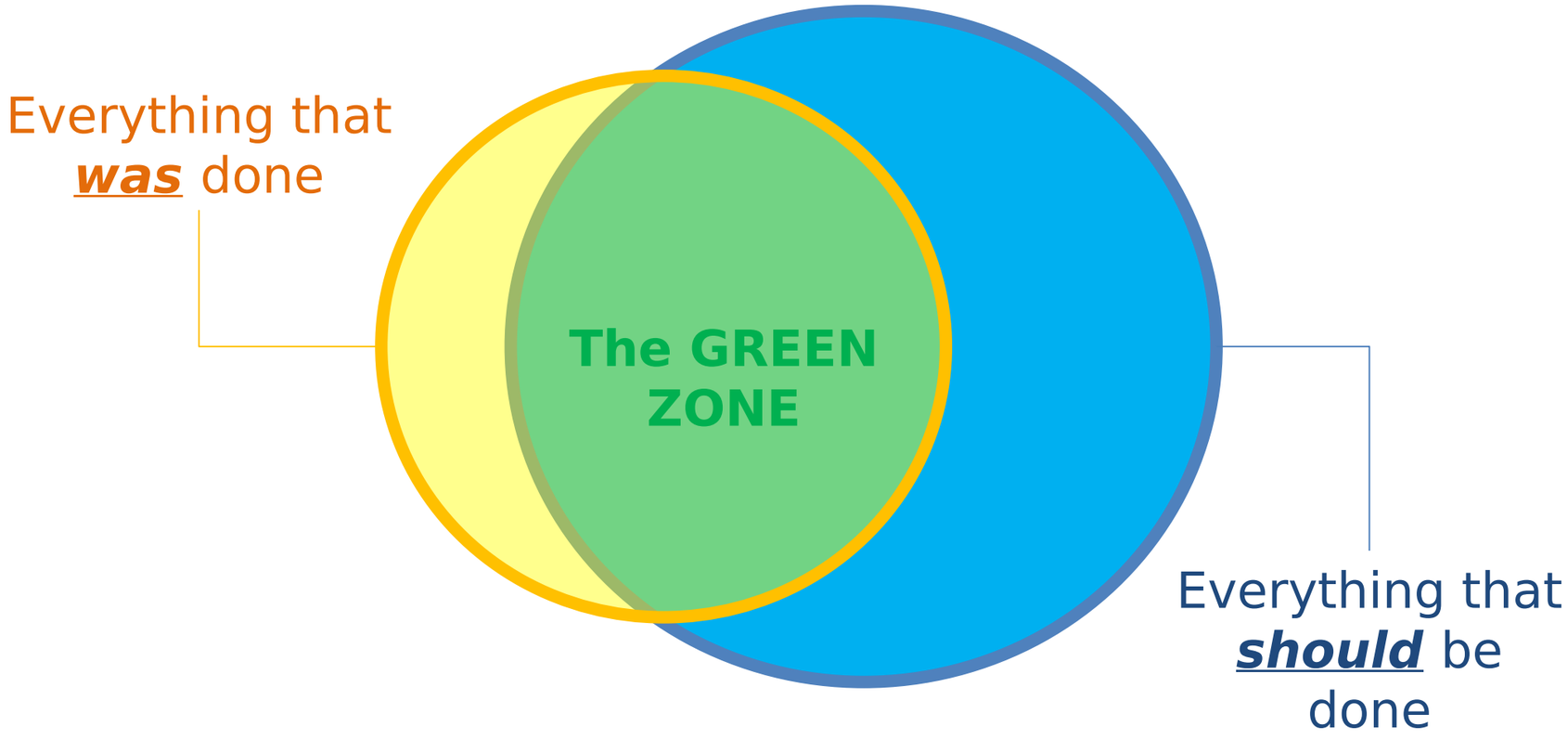
HL7 FHIR Foundation Founder

What are *Computable* Care Guidelines (**CCGs)**?

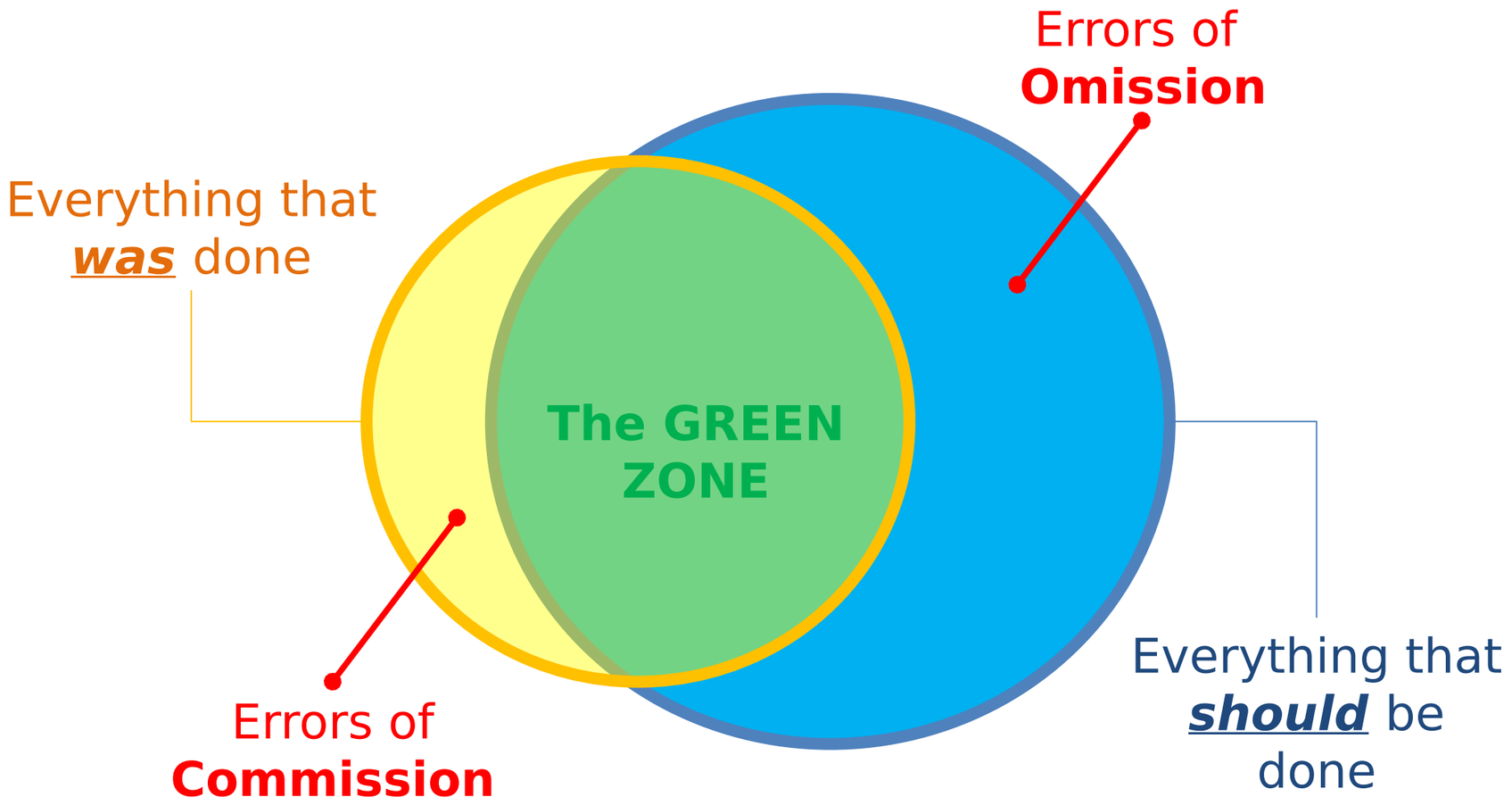
Theory of change:
“We want to ***maximize*** the care delivered in the **GREEN ZONE**.”



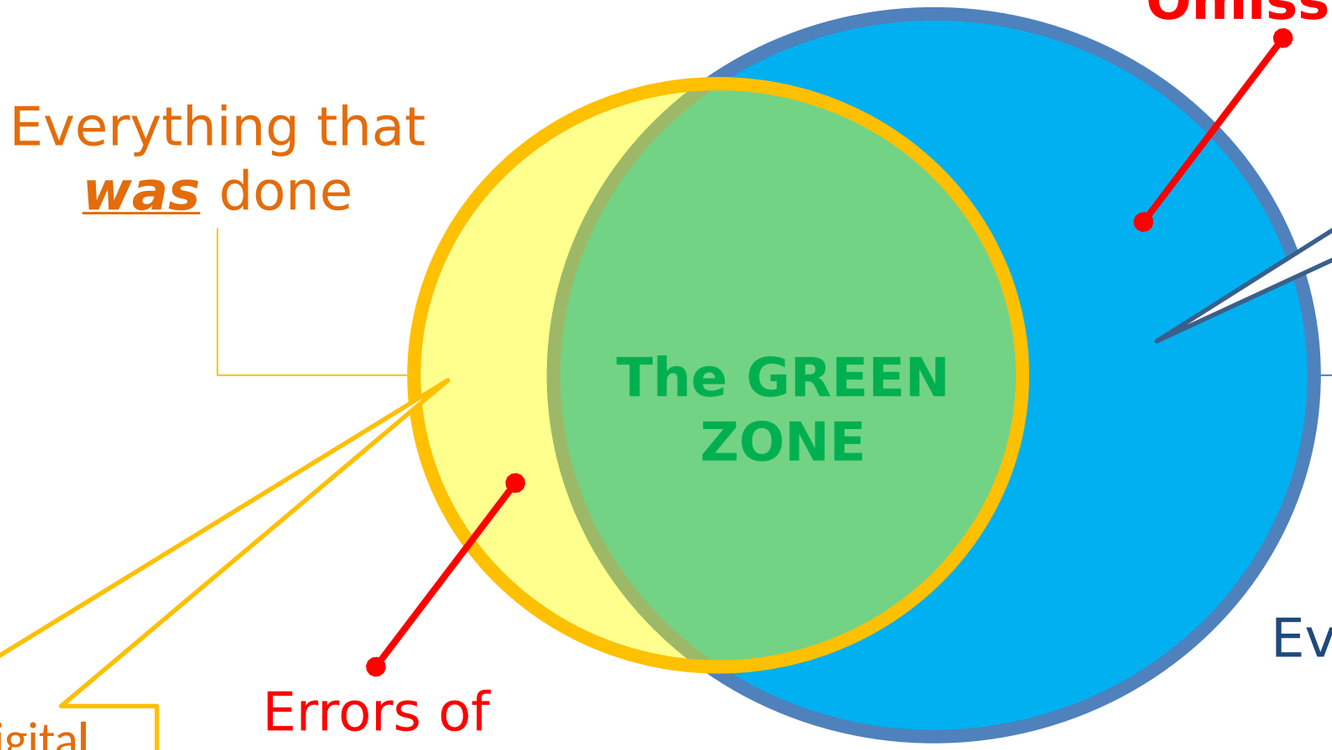
Theory of change:
"We want to ***maximize*** the care delivered in the **GREEN ZONE**."



Theory of change:
"We want to ***maximize*** the care delivered in the **GREEN ZONE**."



Theory of change:
"We want to ***maximize*** the care delivered in the **GREEN ZONE**."

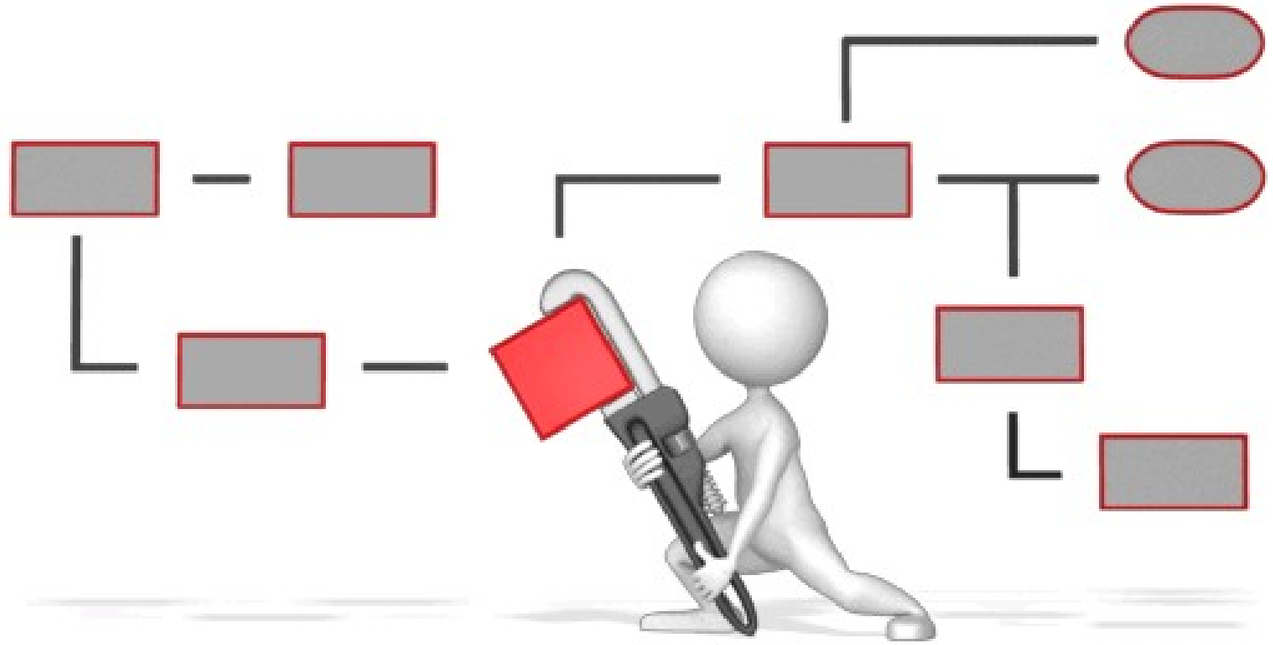


CCGs give us a way to define what ***should*** happen in a way that a computer can understand.

We can use our digital health investments to ***systemically*** increase the "Venn diagram" ***overlap***.

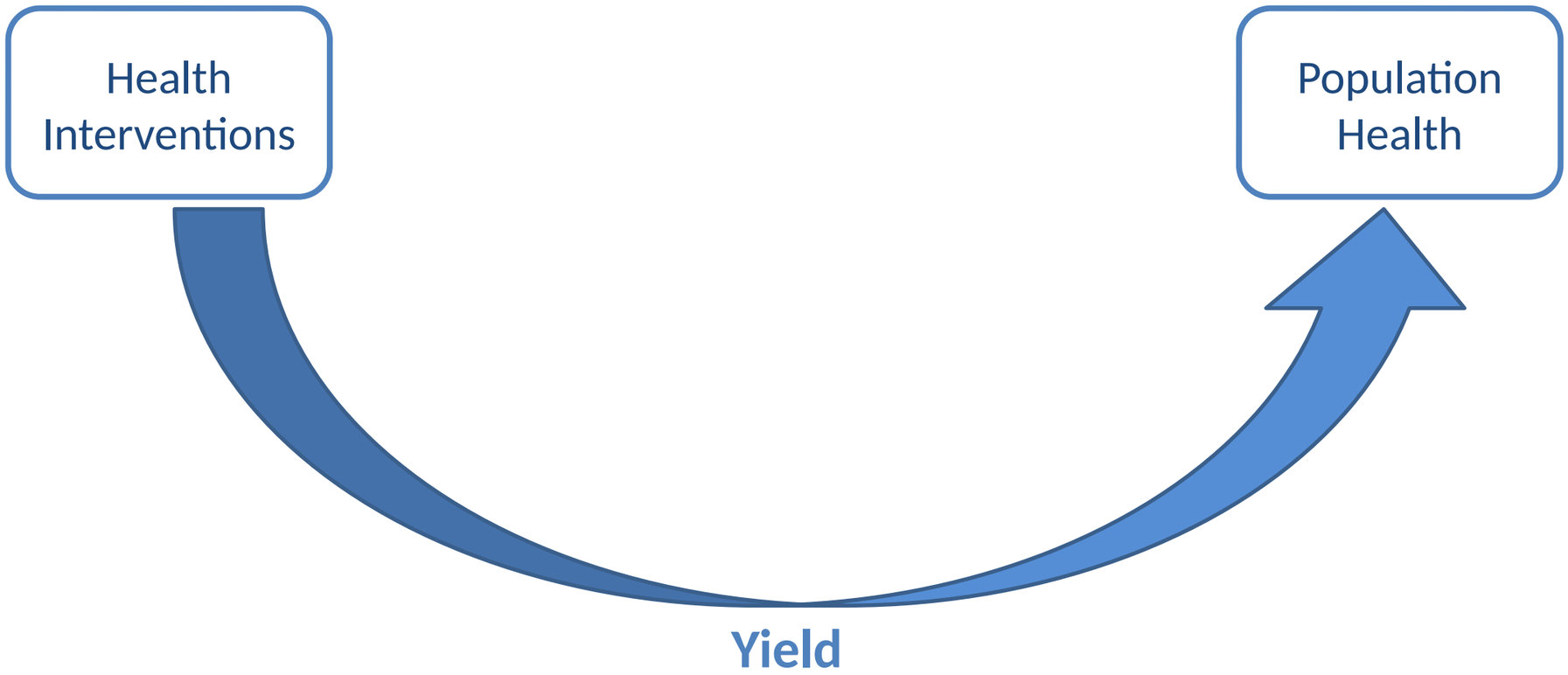
CCG

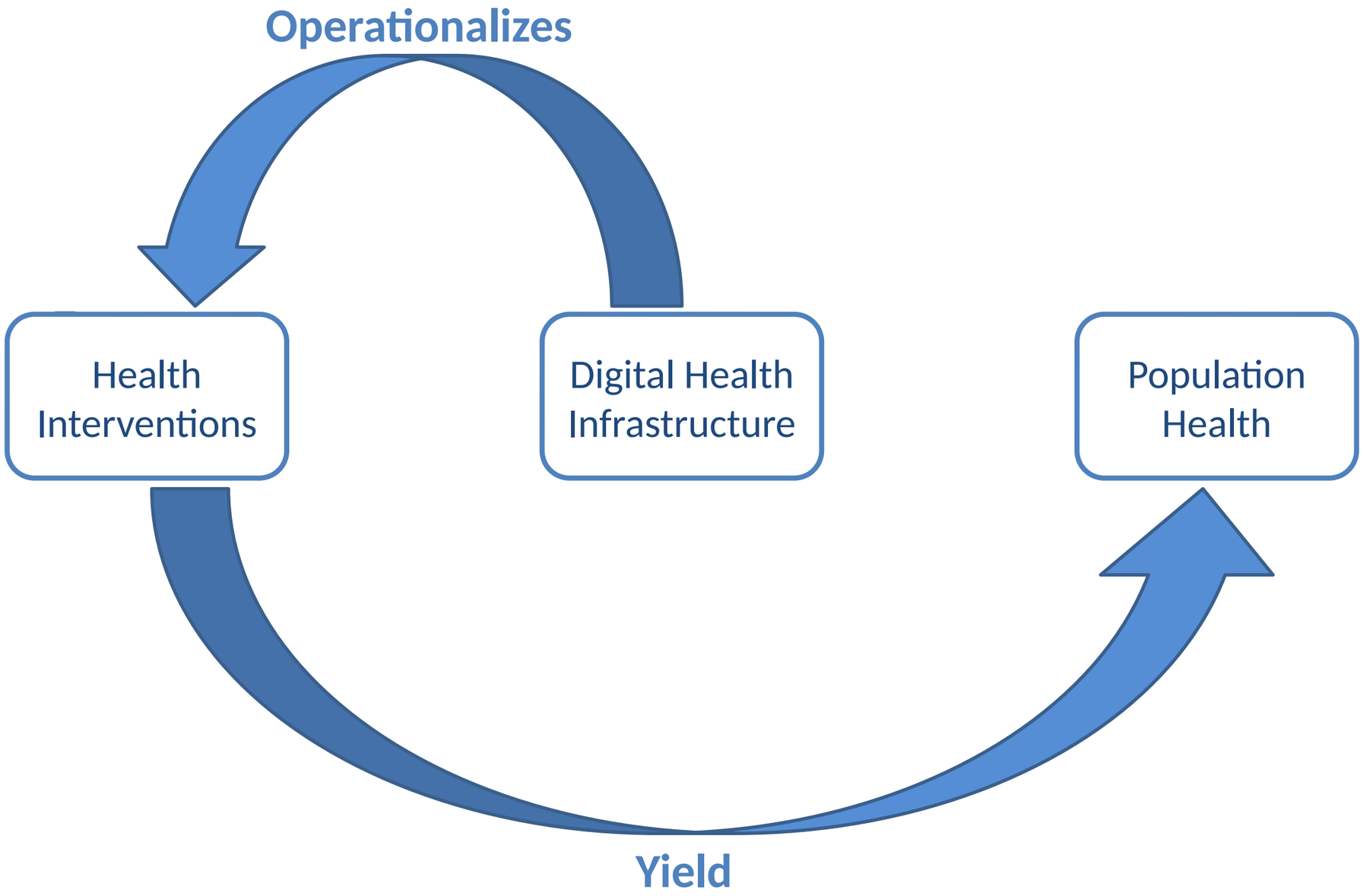
CCGs afford us a way to operationalize ***feedforward process control*** in healthcare.

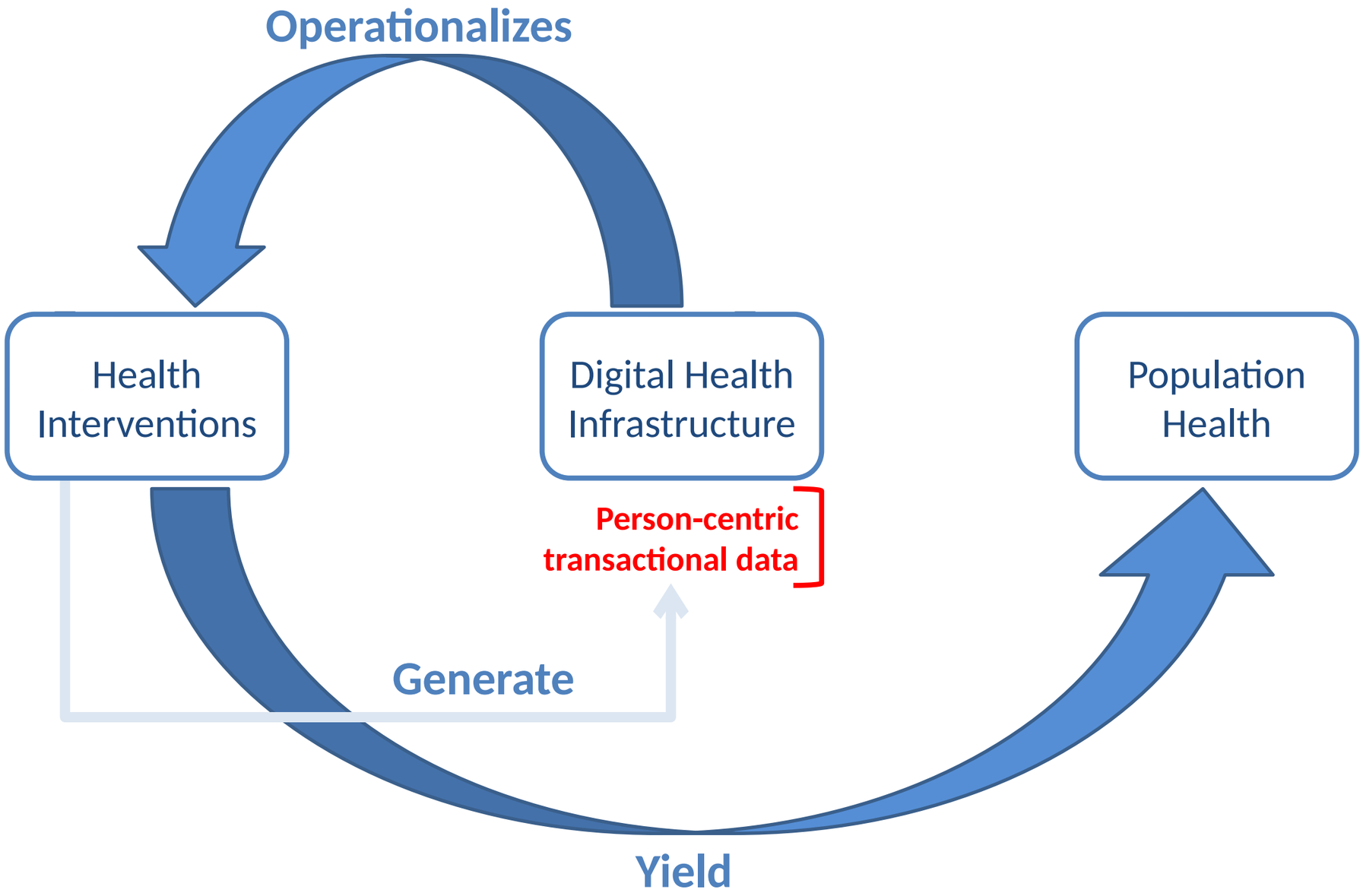


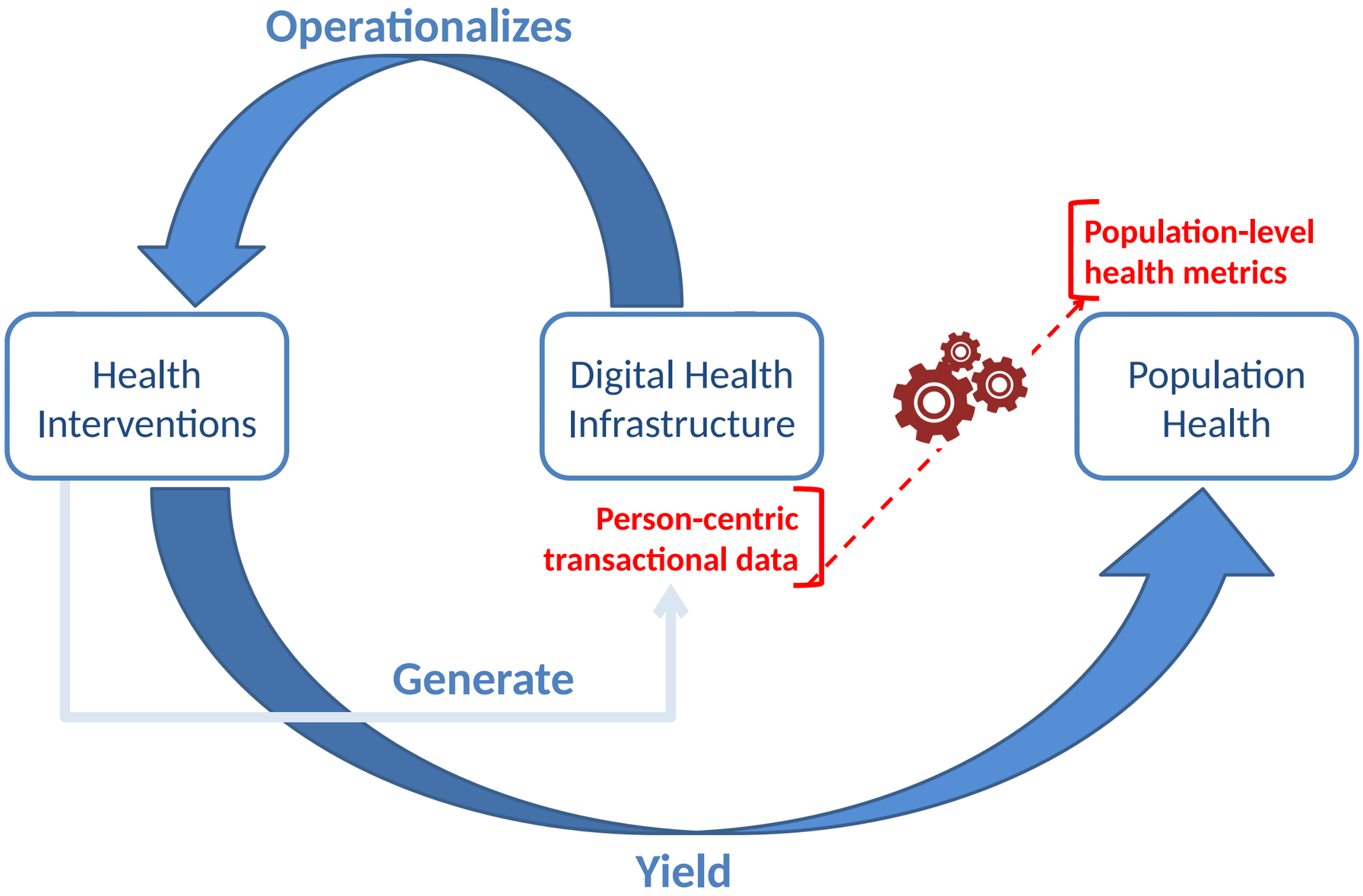

Feedwhatnow?

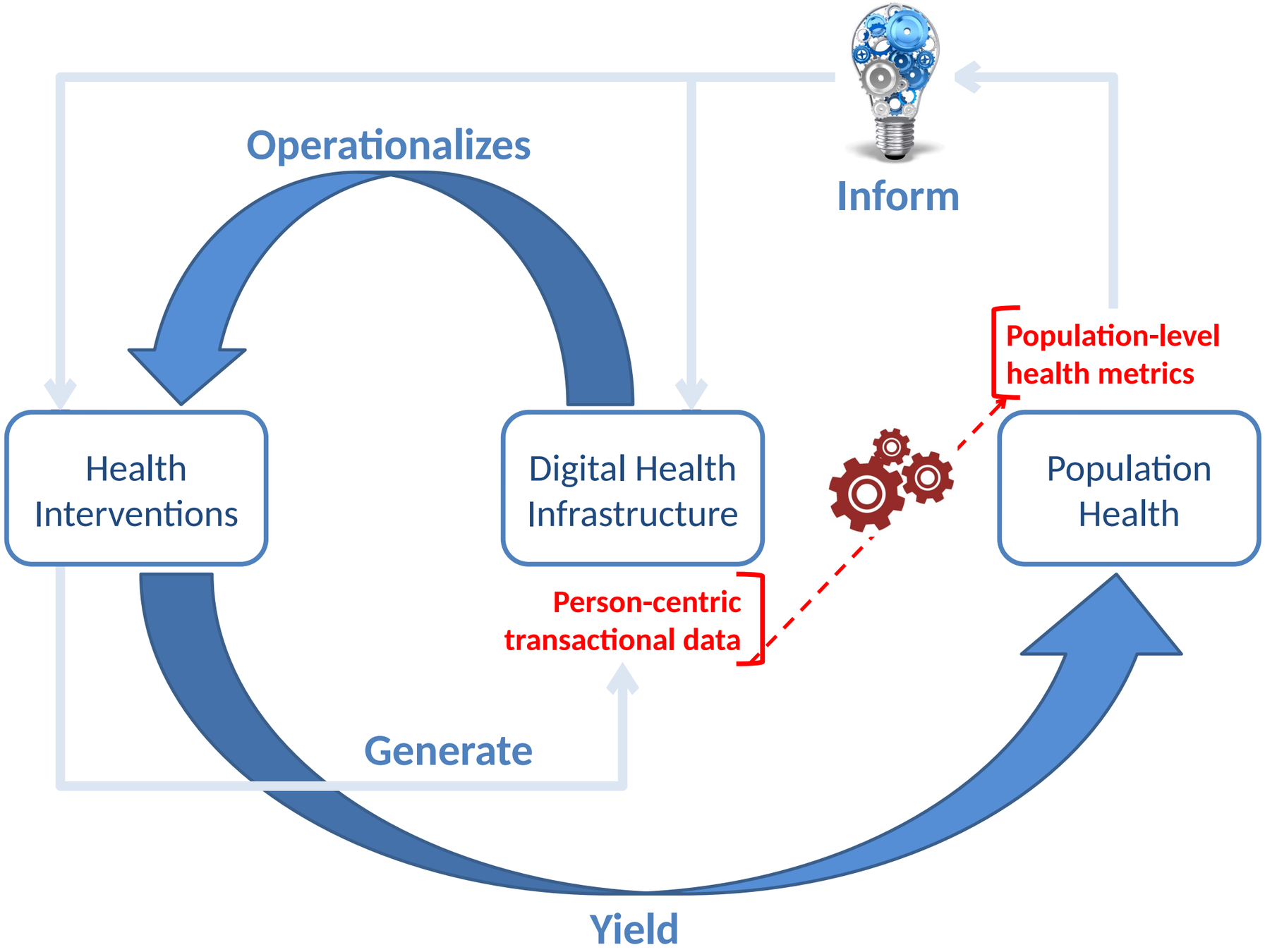

How *digital* **health** impacts upon **health.**

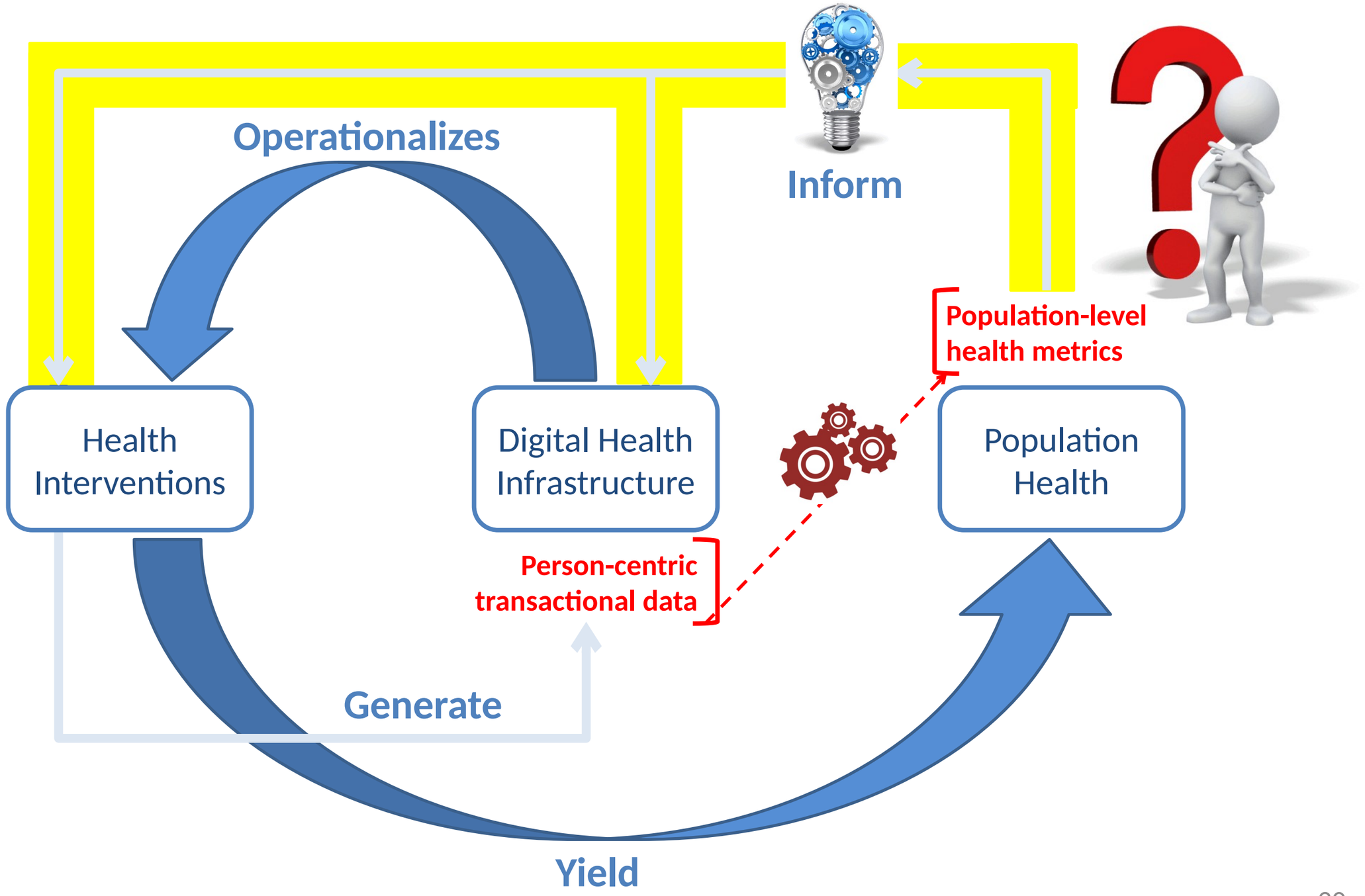

Health Interventions
Population Health
Yield


Operationalizes
Health Interventions
Digital Health Infrastructure
Population Health
Yield


Operationalizes
Health Interventions
Digital Health Infrastructure
Population Health
Person-centric transactional data
Generate
Yield


Operationalizes
Health Interventions
Digital Health Infrastructure
Population Health
Population-level health metrics
Person-centric transactional data
Generate
Yield


Operationalizes
Inform
Health Interventions
Digital Health Infrastructure
Population Health
Population-level health metrics
Person-centric transactional data
Generate
Yield


Operationalizes
Inform
Population-level
health metrics
Health
Interventions
Digital Health
Infrastructure
Population
Health
Person-centric
transactional data
Generate
Yield

Operationalizes

Inform

Health Interventions

Digital Health Infrastructure

Population Health

Population-level health metrics

Person-centric transactional data

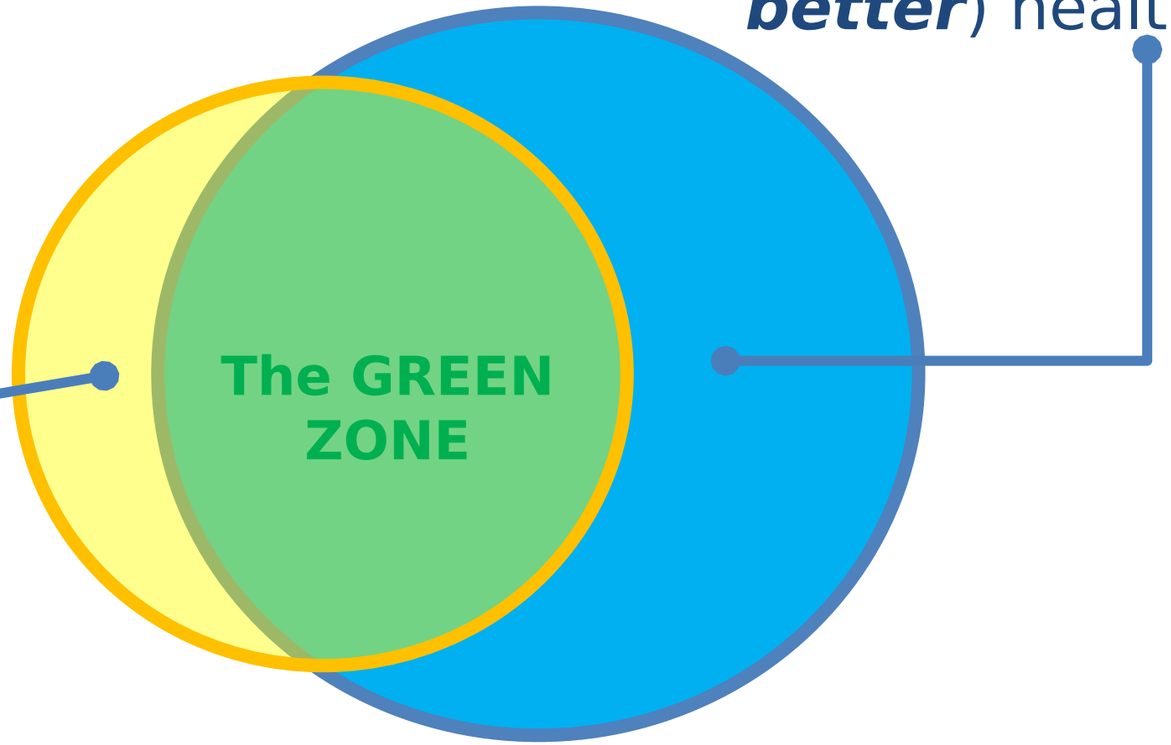
Generate

Yield

What are potential implications for ***AI***?

What if ***omitting*** some “indicated” care activities statistically yields ***identical*** (or even ***better***) health outcomes?

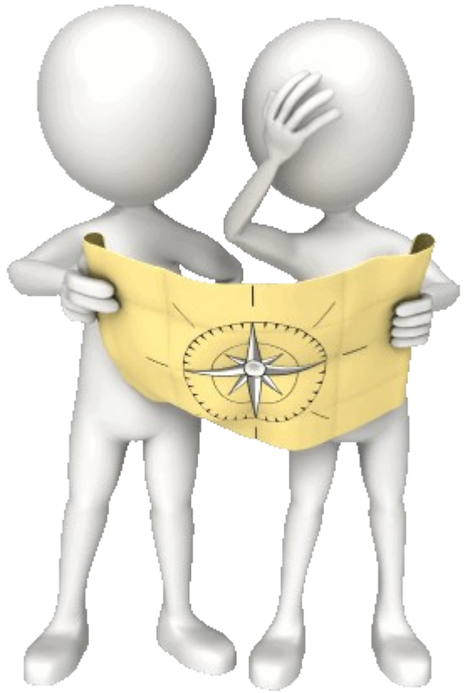
What if some “***non-indicated”*** care activities systemically yield ***<u>better</u>*** health outcomes?



Key takeaway points…

- We can use digital health to both ***meter*** the health system – and to exert ***process control*** upon it.
- Digital health can play an ***industrial engineering*** role. It can be leveraged to improve ***consistency*** in execution of the "***health production function***". This is an example of ***feedforward process control***.
- We should leverage digital health in support of ***care workflows***. Atomic, person-centric data serves ***both*** person-centric ***care*** and population-level ***monitoring***.
- **Analytics** can be leveraged to inform **improvements** to the health system ***operations***, and/or to the digital health supported ***interventions***. This ***feedback*** loop creates a **Learning Health System**.


Q
&
A



What are *Computable* Care Guidelines (**CCGs)**?

Attempt #2 to get Derek to stay focused…

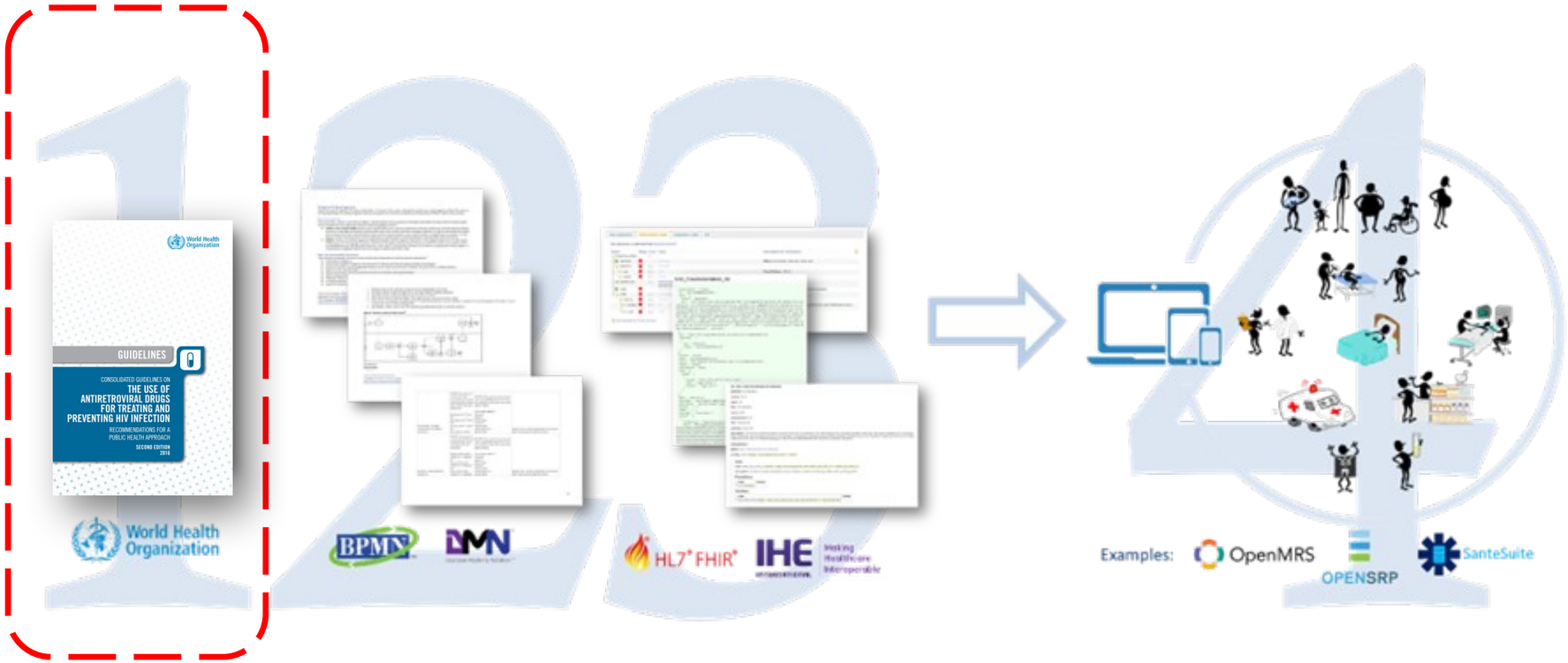
For care guidelines, there are ***four*** levels of ***knowledge representation***.

Level 1: Narrative

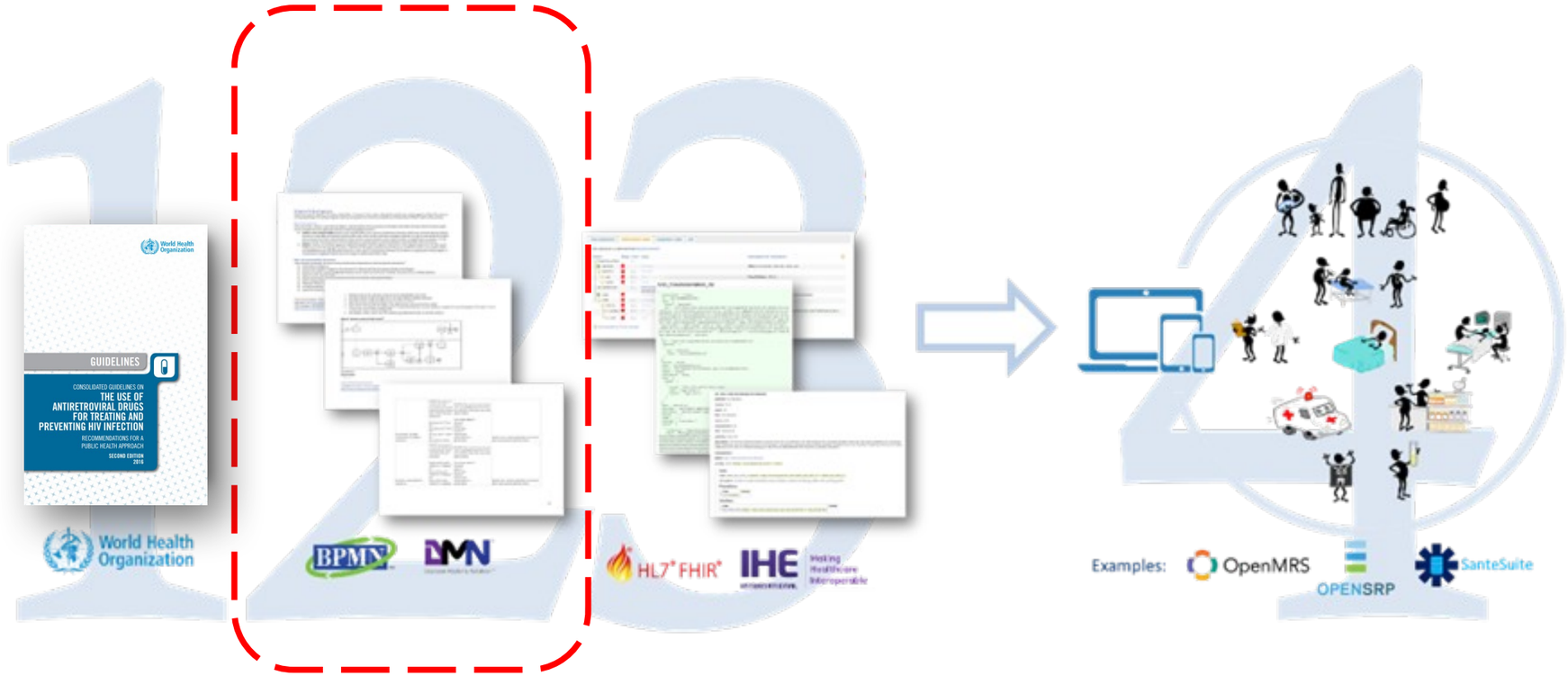
Level 2: Semi-structured

Level 3: Computable

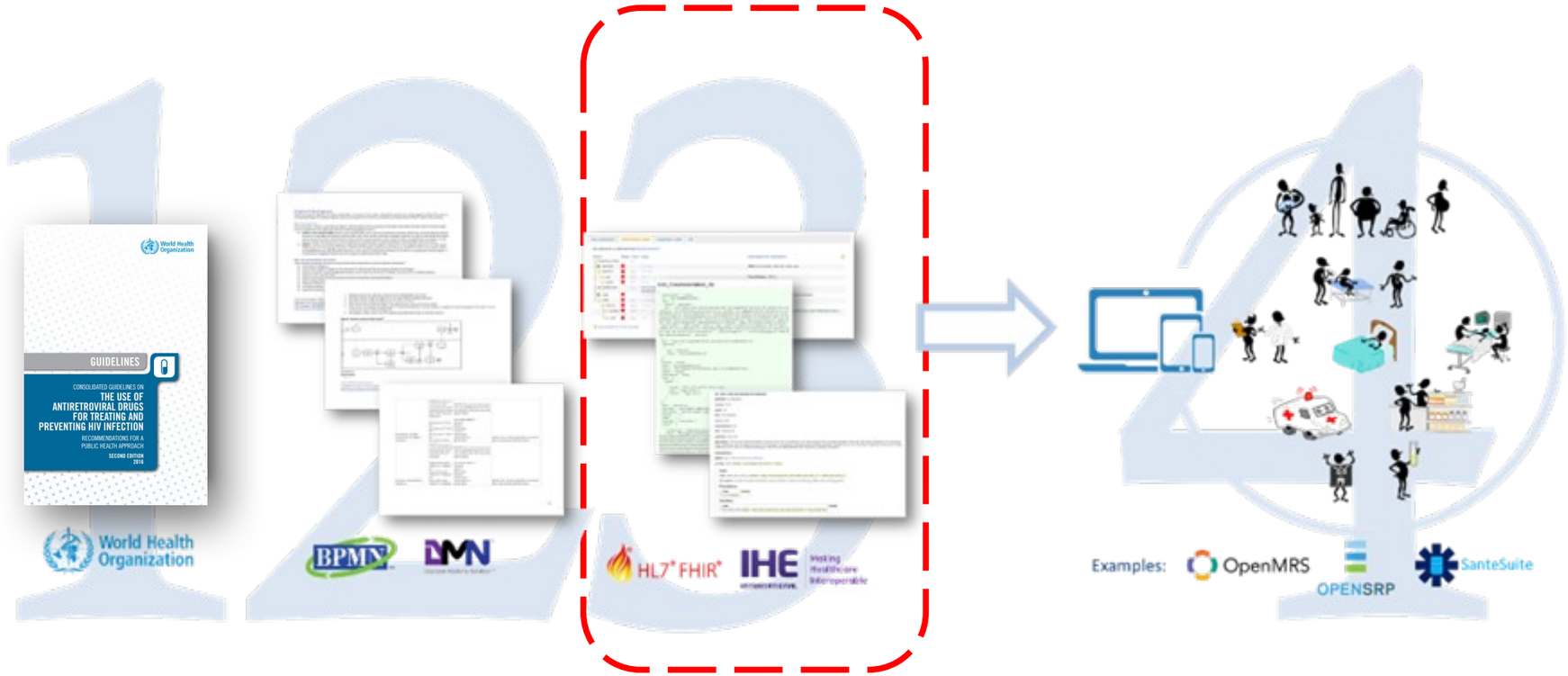
Level 4: Operationalized



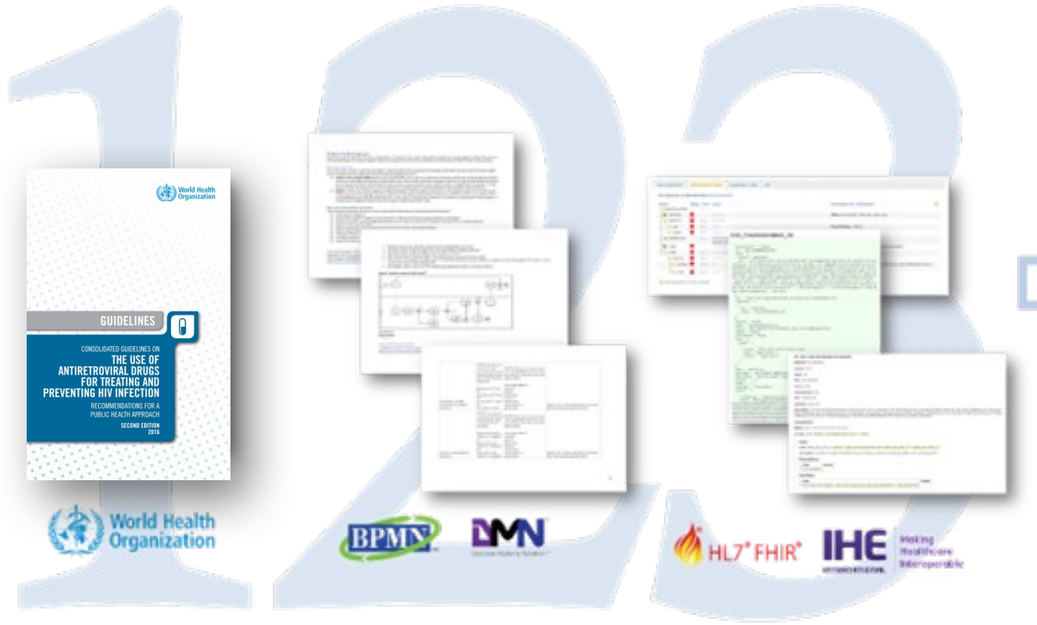
These are ***narrative*** documents intended for **humans**.



These are ***semi-structured*** documents.

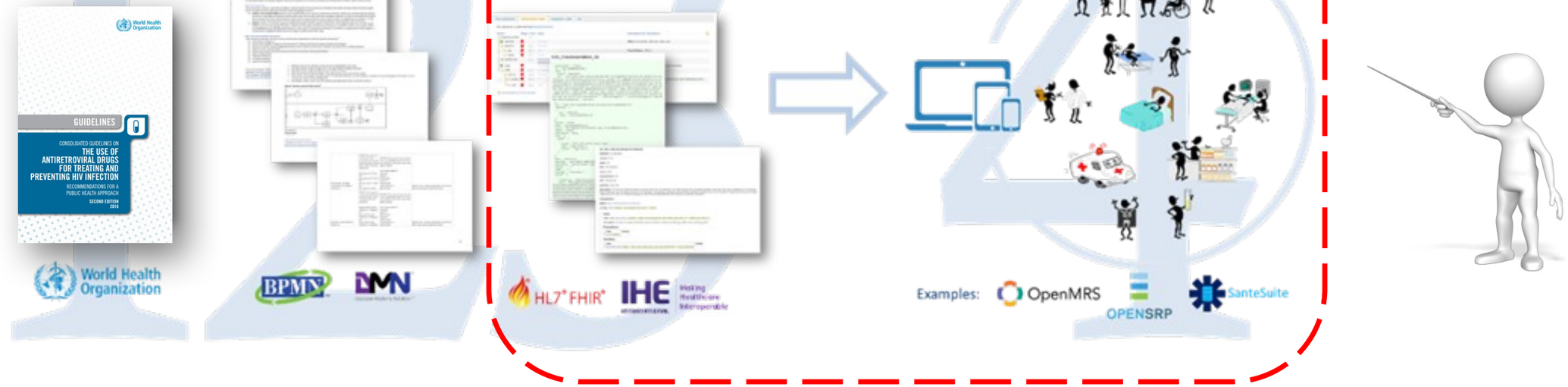


These are **CCGs**.



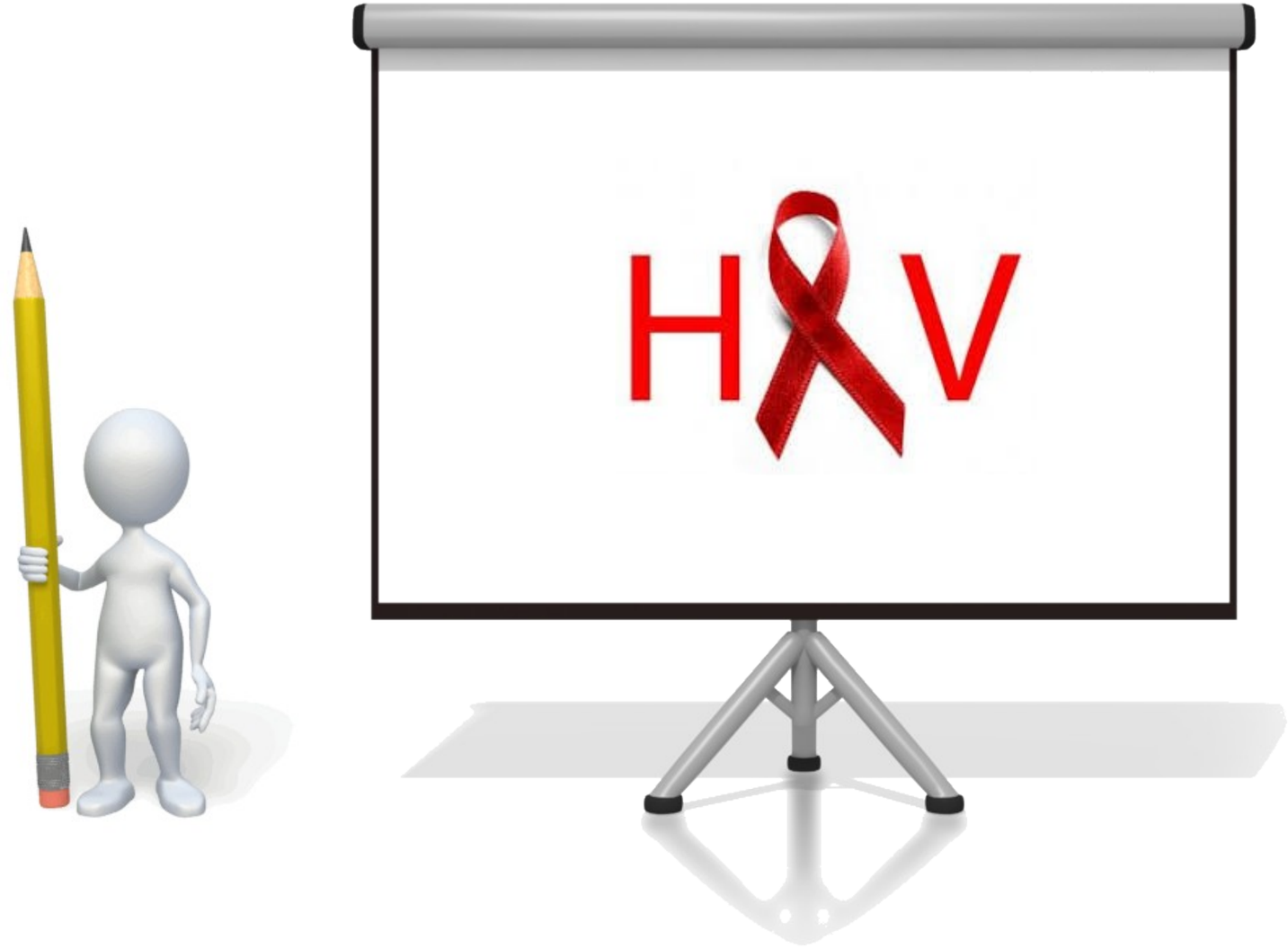
These are digital solutions that ***Operationalize*** CCGs.

This is the focus of **IHE's Conformance-testable CCG Profile.**

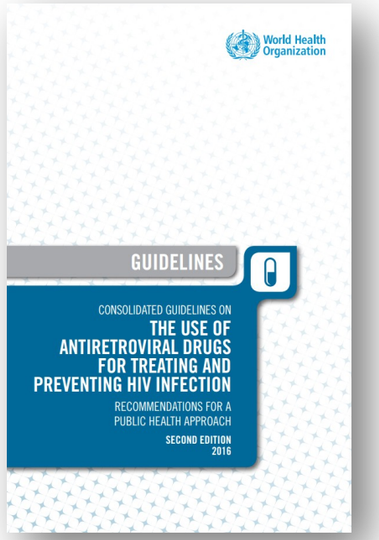


Normative **format** for CCG artefacts

Normative **behaviour** for CCG processors


HIV

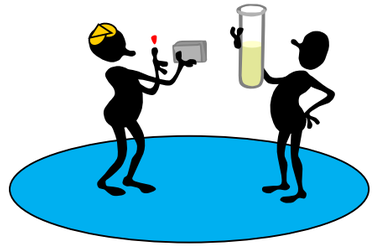
95 – 95 – 95



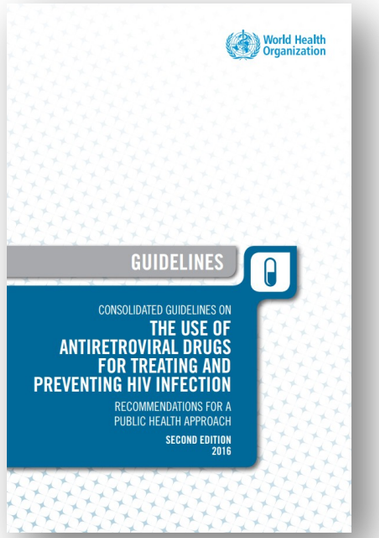
HIV Care Guidelines

VCCT Clinic

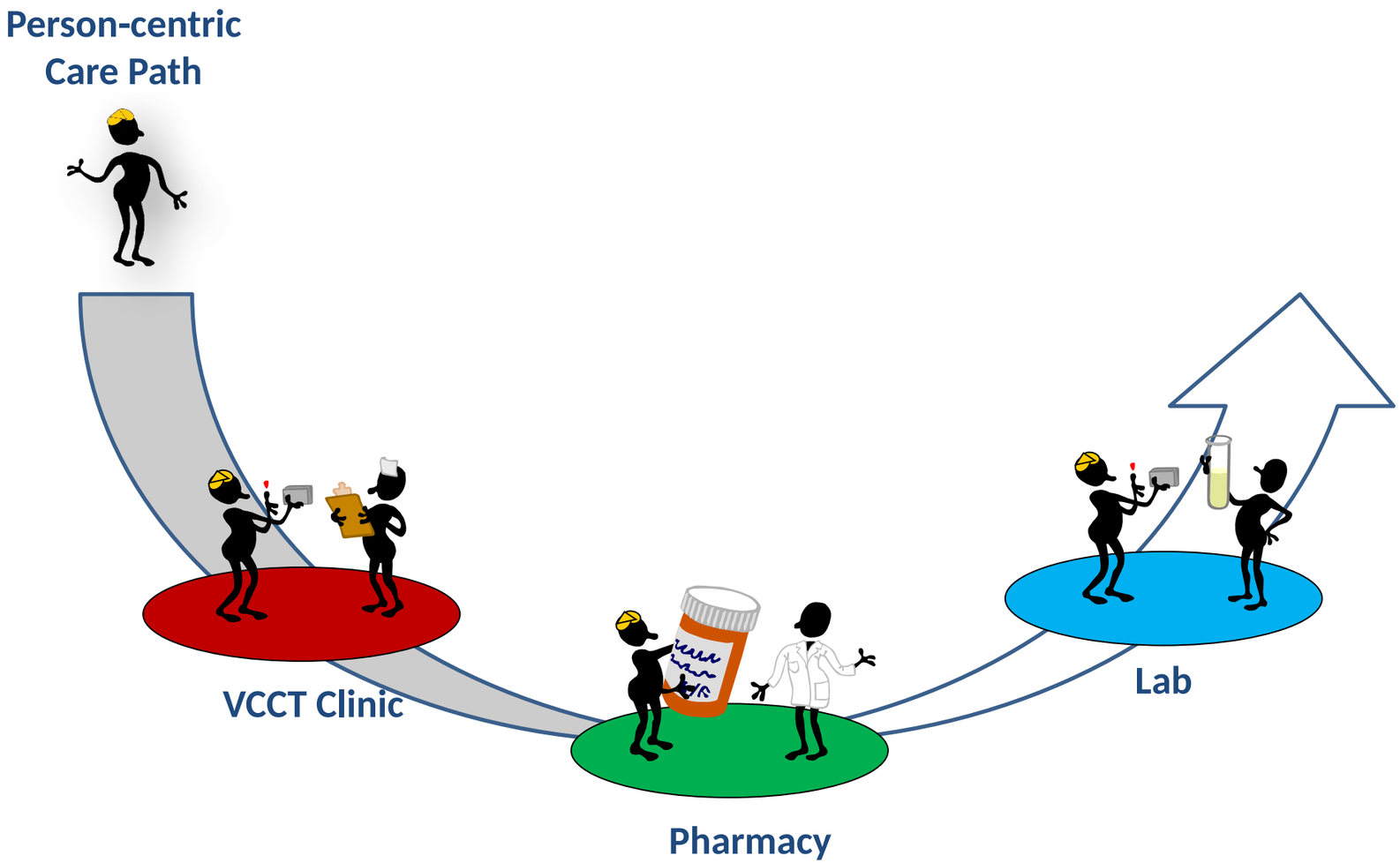
Pharmacy

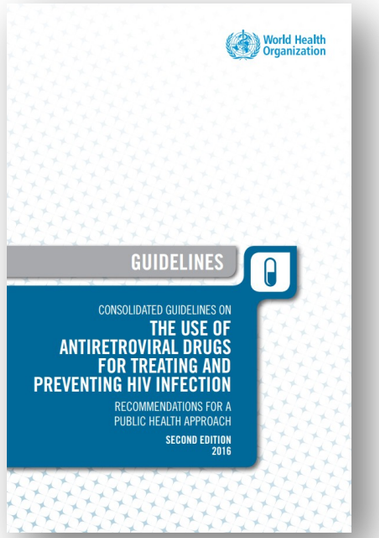


Lab

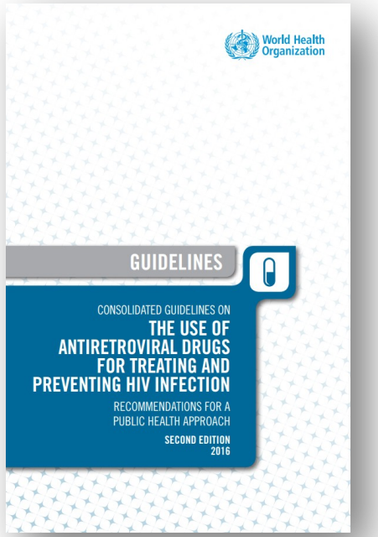


HIV Care Guidelines

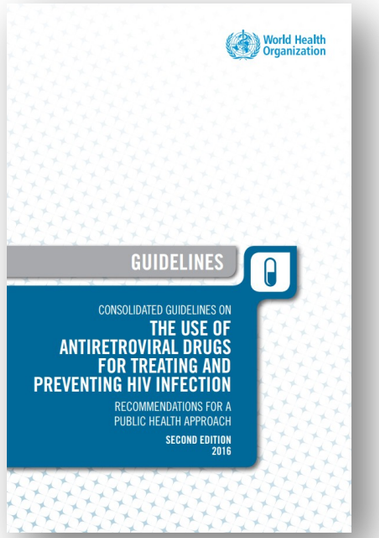




HIV Care Guidelines



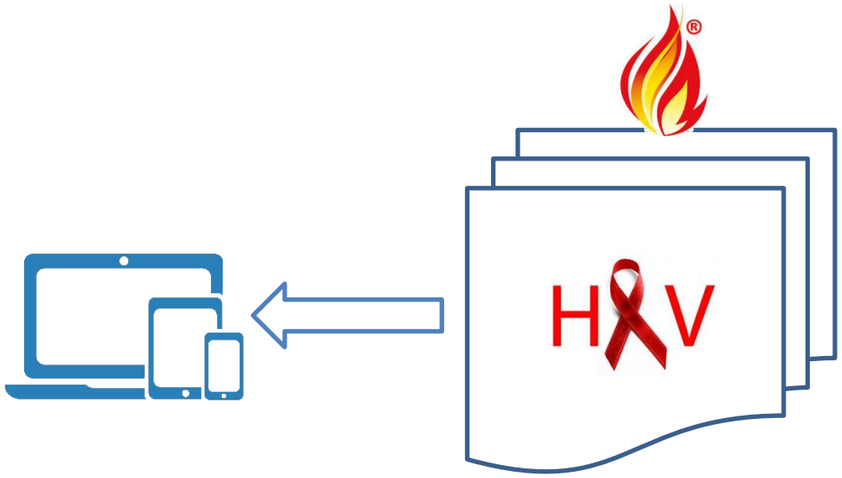
HIV Care Guidelines

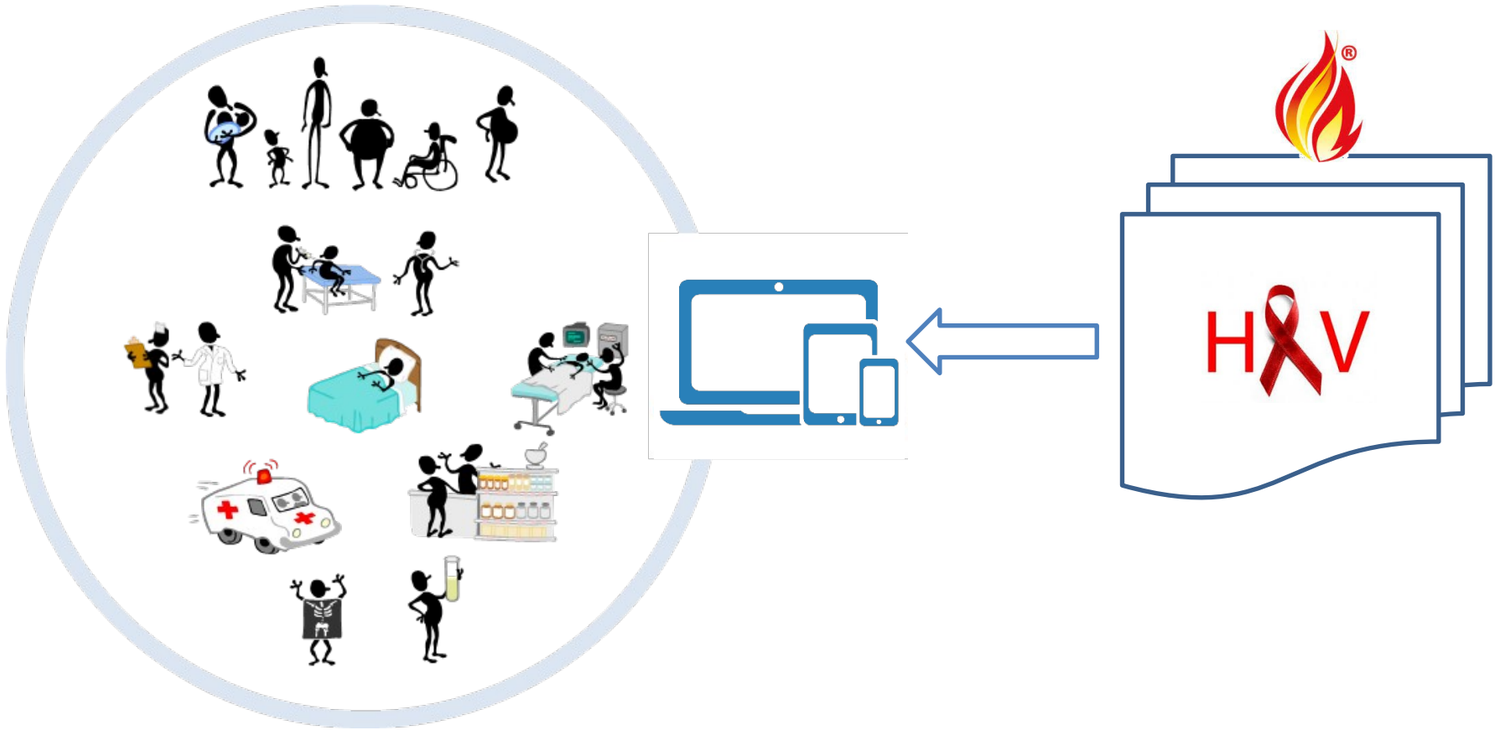


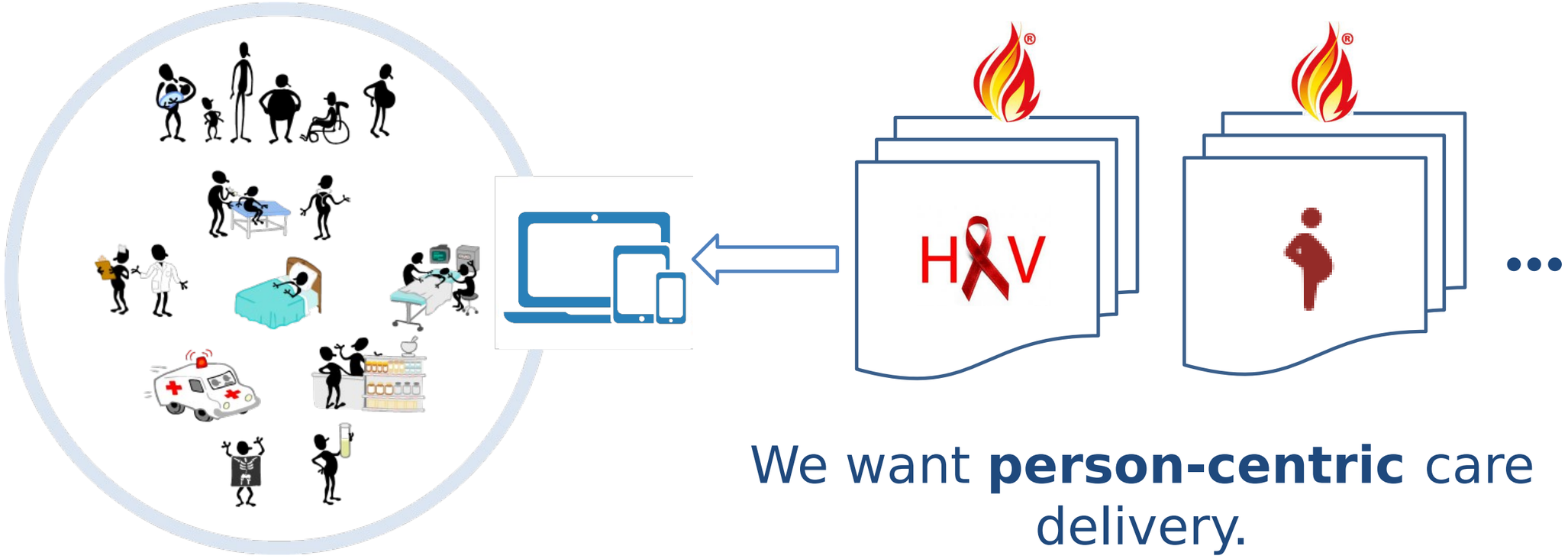
HIV Care Guidelines

Computable Care Guideline for **HIV**

- [ ] Minimum data set
- [ ] Workflow logic
- [ ] Reportable indicators


HIV


HIV



We want **person-centric** care delivery.
There may be more than ***one*** thing to focus on during a care encounter.

Improving the care continuity and care ***quality***, especially for co-morbid patients with ***multiple chronic conditions (MCC)***, addresses a ***big*** and ***expensive*** problem.

In Canada, 73% of persons over 65 years of age suffer from at least one chronic condition , and **30% of Canadians over 35 years of age suffer two or more conditions**. It is estimated the burden of chronic disease represents a cost to the Canadian economy of more than **$190 billion (CAD) annually** and that the direct costs of chronic disease management account for **58% of Canada's total healthcare spend**.

More than **25% of Americans have MCC**, accounting for more than **65% of U.S. healthcare spending**. Projections suggest numbers of adults aged 65 and older will more than double and numbers of those aged 85 and older will triple by 2050.

Currently an estimated ***50 million people in Europe live with multiple chronic conditions*** (multimorbidity), and this number will further increase in the next decade. Especially among people aged 65 and over multimorbidity is common with ***prevalence rates estimated as high as 65%.***

https://www.canada.ca/en/services/health/publications/diseases-conditions/prevalence-chronic-disease-risk-factors-canadians-aged-65-years-older.html

https://build.fhir.org/ig/HL7/fhir-us-mcc/

https://www.nivel.nl/sites/default/files/bestanden/Rapport-State-of-the-Art-ICARE4EU.pdf

The ***care quality problem*** is an issue ***everywhere***, but it is especially stark in low- and middle-income countries (***LMIC***).

"Health care in all global settings today suffers from high levels of defects in quality across many domains, and this poor-quality care causes ongoing damage to human health. ***Hospitalizations*** in low- and middle-income countries (***LMICs***) lead to ***134 million adverse events*** each year, and these adverse events contribute to more than ***2.5 million deaths annually***. More than ***830 million people*** with a diagnosed noncommunicable disease (***NCD***) are not being treated, and more than ***4 million avoidable quality-related deaths*** each year are attributable to ineffective care for NCDs. In total, between ***5.7 and 8.4 million deaths occur annually from poor quality of care in LMICs*** for the selected set of conditions the committee analyzed… which represents between 10 and 15 percent of the total deaths in LMICs reported by the World Health Organization (WHO) in 2015. For some conditions, deaths due to poor quality contribute to more than half of overall deaths."

https://www.nap.edu/catalog/25152/crossing-the-global-quality-chasm-improving-health-care-worldwide

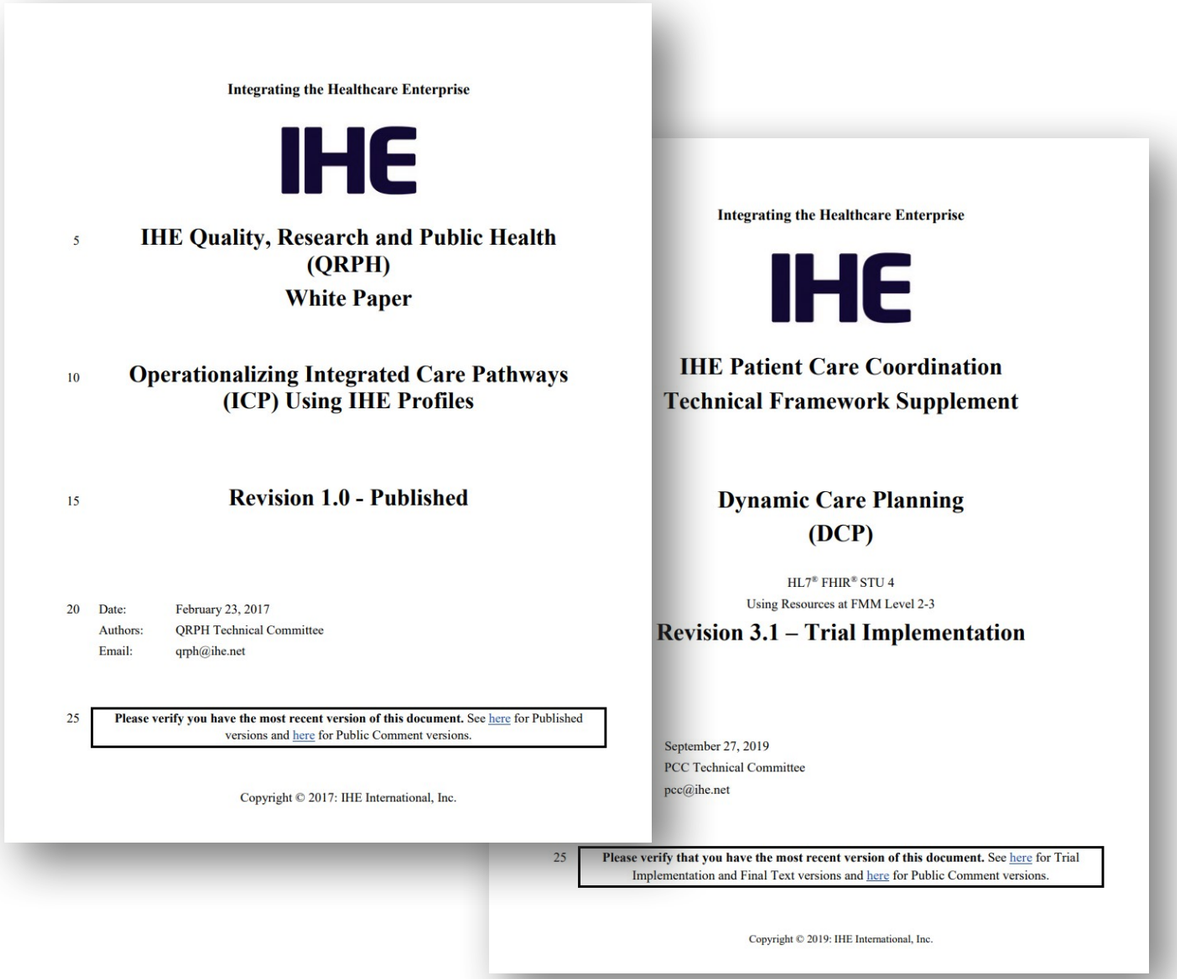
Key takeaway points…

- **CCGs**, at scale, help care delivery networks ***maximize*** care delivered in the **GREEN ZONE**.
- To support ***scale***, CCGs leverage content typically found in a patient's ***shared*** longitudinal electronic health record (**EHR**).
- Digital health solutions that can **ingest** and ***operationalize*** CCGs are the ***antithesis*** of "siloed app" care solutions that focus only on a single disease or care pathway.
- Multiple well-formed CCGs can be ***concurrently executed*** to enable truly ***person-centric care*** (e.g. care for a woman who is pregnant ***and*** HIV+).
- This is a ***problem worth solving!***


Q
&
A

Who has been making progress on ***scaling*** computable decision support… and what can we ***learn*** from their experiences?

IHE's QRPH published an "Integrated Care Pathways" white paper in **2017** and launched the CCG Profile effort in **2018**. PCC published DCP in **2016**.



Integrating the Healthcare Enterprise

IHE

IHE Quality, Research and Public Health (QRPH)
White Paper

Operationalizing Integrated Care Pathways (ICP) Using IHE Profiles

Revision 1.0 - Published

Date: February 23, 2017
Authors: QRPH Technical Committee
Email: qrph@ihe.net

Please verify you have the most recent version of this document. See here for Published versions and here for Public Comment versions.

Copyright © 2017: IHE International, Inc.

Integrating the Healthcare Enterprise

IHE

IHE Patient Care Coordination Technical Framework Supplement

Dynamic Care Planning (DCP)

HL7® FHIR® STU 4
Using Resources at FMM Level 2-3

Revision 3.1 – Trial Implementation

September 27, 2019
PCC Technical Committee
pcc@ihe.net

Please verify that you have the most recent version of this document. See here for Trial Implementation and Final Text versions and here for Public Comment versions.

Copyright © 2019: IHE International, Inc.

IHE's Quality, Research and Public Health (***QRPH***) committee conducted a prototyping effort in 2015/16 to see if Business Process Modeling Notation (***BPMN)*** could be used to describe CCGs.

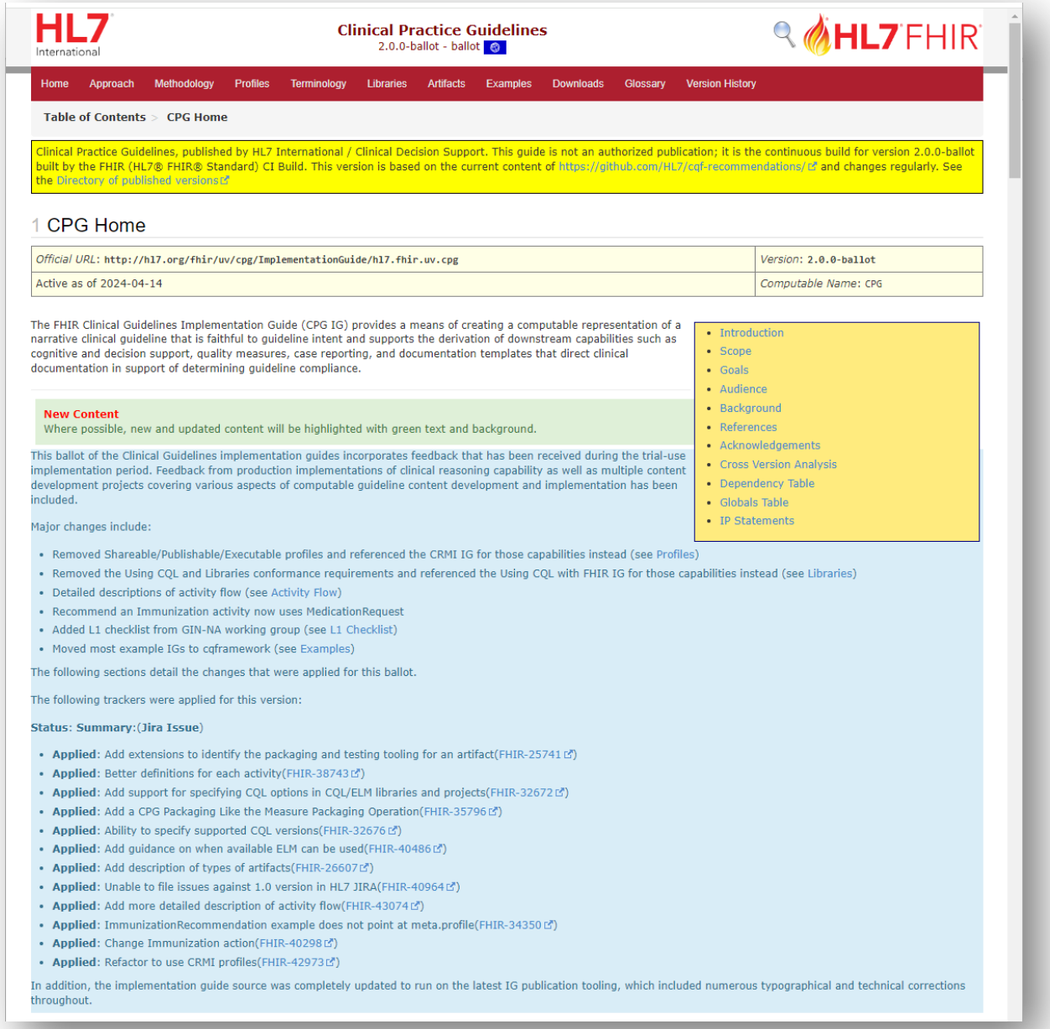
The Patient Care Coordination committee (***PCC***) defined a FHIR-based Profile for Dynamic Care Planning (***DCP***) in 2016 (last update 2019).

The ***IHE CCG Profile*** work item was approved and launched by QRPH-PCC (jointly) in ***2018***.

https://www.ihe.net/uploadedFiles/Documents/QRPH/IHE_QRPH_WP_IHE4ICP.pdf

https://www.ihe.net/uploadedFiles/Documents/PCC/IHE_PCC_Suppl_DCP.pdf

Since **2019**, HL7 and IHE are ***partners*** on CCG development.



HL7 International

Clinical Practice Guidelines
2.0.0-ballot - ballot

HL7 FHIR

Home | Approach | Methodology | Profiles | Terminology | Libraries | Artifacts | Examples | Downloads | Glossary | Version History

Table of Contents > CPG Home

Clinical Practice Guidelines, published by HL7 International / Clinical Decision Support. This guide is not an authorized publication; it is the continuous build for version 2.0.0-ballot built by the FHIR (HL7® FHIR® Standard) CI Build. This version is based on the current content of https://github.com/HL7/cqf-recommendations/ and changes regularly. See the Directory of published versions

1 CPG Home

Official URL: http://hl7.org/fhir/uv/cpg/ImplementationGuide/hl7.fhir.uv.cpg	*Version*: 2.0.0-ballot
Active as of 2024-04-14	*Computable Name*: CPG

The FHIR Clinical Guidelines Implementation Guide (CPG IG) provides a means of creating a computable representation of a narrative clinical guideline that is faithful to guideline intent and supports the derivation of downstream capabilities such as cognitive and decision support, quality measures, case reporting, and documentation templates that direct clinical documentation in support of determining guideline compliance.

- Introduction
- Scope
- Goals
- Audience
- Background
- References
- Acknowledgements
- Cross Version Analysis
- Dependency Table
- Globals Table
- IP Statements

New Content
Where possible, new and updated content will be highlighted with green text and background.

This ballot of the Clinical Guidelines implementation guides incorporates feedback that has been received during the trial-use implementation period. Feedback from production implementations of clinical reasoning capability as well as multiple content development projects covering various aspects of computable guideline content development and implementation has been included.

Major changes include:

- Removed Shareable/Publishable/Executable profiles and referenced the CRMI IG for those capabilities instead (see Profiles)
- Removed the Using CQL and Libraries conformance requirements and referenced the Using CQL with FHIR IG for those capabilities instead (see Libraries)
- Detailed descriptions of activity flow (see Activity Flow)
- Recommend an Immunization activity now uses MedicationRequest
- Added L1 checklist from GIN-NA working group (see L1 Checklist)
- Moved most example IGs to cqframework (see Examples)

The following sections detail the changes that were applied for this ballot.

The following trackers were applied for this version:

Status: **Summary**:(**Jira Issue**)

- **Applied**: Add extensions to identify the packaging and testing tooling for an artifact(FHIR-25741)
- **Applied**: Better definitions for each activity(FHIR-38743)
- **Applied**: Add support for specifying CQL options in CQL/ELM libraries and projects(FHIR-32672)
- **Applied**: Add a CPG Packaging Like the Measure Packaging Operation(FHIR-35796)
- **Applied**: Ability to specify supported CQL versions(FHIR-32676)
- **Applied**: Add guidance on when available ELM can be used(FHIR-40486)
- **Applied**: Add description of types of artifacts(FHIR-26607)
- **Applied**: Unable to file issues against 1.0 version in HL7 JIRA(FHIR-40964)
- **Applied**: Add more detailed description of activity flow(FHIR-43074)
- **Applied**: ImmunizationRecommendation example does not point at meta.profile(FHIR-34350)
- **Applied**: Change Immunization action(FHIR-40298)
- **Applied**: Refactor to use CRMI profiles(FHIR-42973)

In addition, the implementation guide source was completely updated to run on the latest IG publication tooling, which included numerous typographical and technical corrections throughout.

https://build.fhir.org/ig/HL7/cqf-recommendations/

The ***CCG Gemini Project*** is an HL7-IHE collaboration that has been underway since ***2019***.

IHE's role in the partnership is to profile (and simplify) the underlying HL7 specifications in support of implementability and ***conformance-testability***.

The HL7 ***CPG-on-FHIR IG*** is presently completing its 2nd STU ballot. It is based on FHIR **R4**.

IHE has been a contributor on the WHO ***SMART Guidelines*** project.

Since 2019, ***both*** Gemini partners have been active members of a WHO-led CCG initiative: ***SMART Guidelines***.

The SMART Guideline initiative is strategic for WHO. Work has progressed on "DAKs" for ANC, HIV, Immunization, and IMCI.

NOTE: WHO does ***not*** plan to follow the current proposal re: **IHE's** CCG Profile.

https://www.who.int/teams/digital-health-and-innovation/smart-guidelines

For conformance-testing, the US ONC requires CDS solutions' logic to be based on **C-CDA (PS): IHE Health Story Consolidation**.

The Office of the National Coordinator for Health Information Technology

2015 Edition §170.315(a)(9) Clinical Decision Support
Testing Components: Health IT developer self-declaration to the testing outcomes
Test Procedure Version 1.3 – Last Updated 09/21/17

Please consult the Final Rule entitled: *2015 Edition Health Information Technology (Health IT) Certification Criteria, 2015 Edition Base Electronic Health Record (EHR) Definition, and ONC Health IT Certification Program Modifications* for a detailed description of the certification criterion with which these testing steps are associated. We also encourage developers to consult the Certification Companion Guide in tandem with the test procedure as they provide clarifications that may be useful for product development and testing.

Note: The order in which the test steps are listed reflects the sequence of the certification criterion and does not necessarily prescribe the order in which the test should take place.

Required Tests

(a)(9)(i) *CDS intervention interaction*. Interventions provided to a user must occur when a user is interacting with technology.

Cross Reference Criteria: §170.315(a)(5)(i) Preferred language, sex, race, ethnicity, and date of birth

Standard(s): §170.205(a)(3) - HL7 Implementation Guide for CDA® Release 2: IHE Health Story Consolidation, DSTU Release 1.1 (US Realm) Draft Standard for Trial
§170.205(a)(4) - HL7 Implementation Guide for CDA Release 2: Consolidated CDA Templates for Clinical Notes, DSTU, Release 2.1
§170.207(f)(2) – CDC Race and Ethnicity Code Set Version 1.0 (March 2000)
§170.207(f)(1) - OMB standards for Maintaining, Collecting, and Presenting Federal Data on Race and Ethnicity, Statistical Policy Directive No. 15, as revised, October 30, 1997
§170.207(g)(2) – Request for Comments (RFC) 5646
§170.207(n)(1) - Birth sex must be coded in accordance with HL7 Version 3 attributed as follows: Male (M), Female (F), Unknown (UNK)

The Office of the National Coordinator for Health Information Technology

Criteria ¶	System Under Test	Test Lab Verification
(i)	1. The user interacts with the Health IT Module, and clinical decision support (CDS) interventions are provided based on each data element and one combination of the following: (A) Problem list; (B) Medication list; (C) Medication allergy list; (D) At least one demographic specified in §170.315(a)(5)(i); (E) Laboratory tests; and (F) Vital signs. 2. The health IT developer demonstrates receiving a transition of care/referral summary to provide CDS interventions based on the incorporated data: • Medications; • Medication allergies; and • Problems.	1. The tester verifies that the CDS interventions are based on interactions with the system and based on all of the data elements listed (A-F) and one combination of the data elements. 2. The tester verifies that CDS interventions are provided when medications, medication allergies, and problems are received and incorporated into the patient's record from a transition of care/referral summary.

(ii) *CDS configuration.*

(A) Enable interventions and reference resources specified in paragraphs (a)(9)(iii) and (iv) of this section to be configured by a limited set of identified users (e.g., system administrator) based on a user's role.

(B) Enable interventions:

(1) Based on the following data:
- *(i)* Problem list;
- *(ii)* Medication list;
- *(iii)* Medication allergy list;
- *(iv)* At least one demographic specified in paragraph (a)(5)(i) of this section;
- *(v)* Laboratory tests; and
- *(vi)* Vital signs.

(2) When a patient's medications, medication allergies, and problems are incorporated from a transition of care/referral summary received and pursuant to paragraph (b)(2)(iii)(D) of this section.

Standard(s): None

*the ONC's CDS content stipulation is consistent with the content found in the **IPS**.

https://www.healthit.gov/test-method/clinical-decision-support-cds

The *global* equivalent of the US C-CDA is the **International Patient Summary** (IPS). IPS is used for ***care continuity*** & **CDS** in many countries.

- **Canada** – PS:CA is a profiling of IPS for **domestic** care continuity. It is expected to support CDS (Ontario's CDS use cases are an active example of this).
- **Denmark** – CDA based PS supporting CDS for COPD, Type-II Diabetes, and heart failure. Moving to FHIR.
- **GravitateHealth** (multi-EU country project) – IPS supporting CDS (especially re: medications).
- **Myanmar**, **Cambodia**, **Botswana** – OpenHIE-on-FHIR (IPS) based national HIE efforts targeting to support national CCG initiatives.

https://international-patient-summary.net/implementations-across-the-globe/

Key takeaway points…

- HL7 has progressed the ***CPG-on-FHIR IG***; it is the ***underlying standard*** for IHE's CCG Profile.
- WHO has progressed its ***SMART Guideline*** effort and has begun publishing Digital Accelerator Kits (DAKs) plus an ***L3 Antenatal care*** artefact.
- ***Conformance-testable*** implementations in the ***USA***, ***Denmark*** and ***NHS Scotland*** have adopted **common data models** based on ***patient summary*** specs:
  - C-CDA IHE Health Story Consolidation
  - USCDI (us-core) FHIR profile
  - European PS (precursor to IPS)
  - NHS Shared Care Record (SCR)
- ***Concurrent*** execution of ***multiple CCGs*** is a must-have requirement to address ***MCC***.

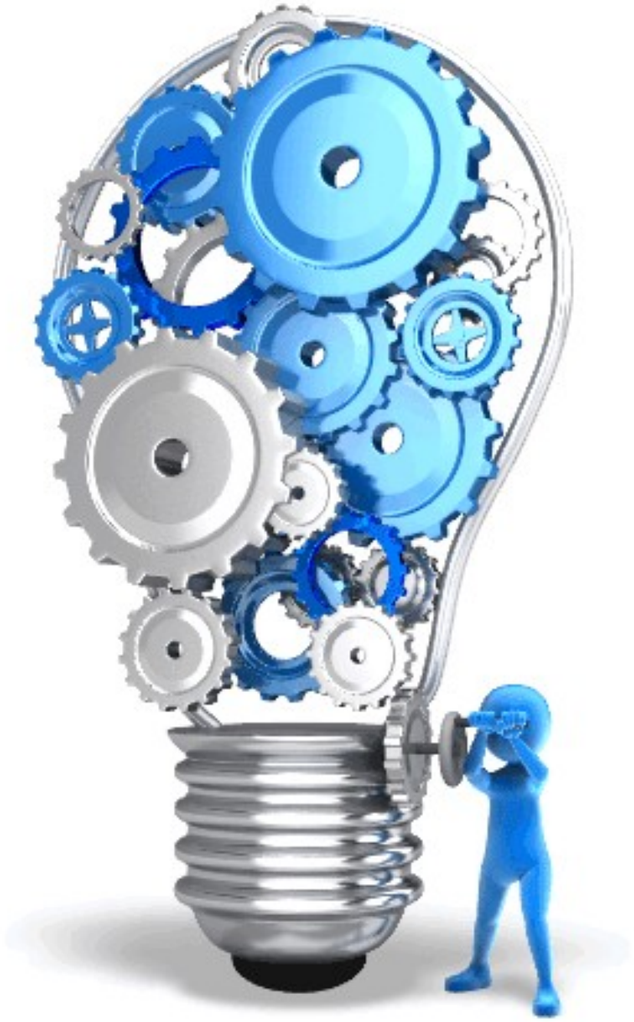

Q
&
A

SMART Digital Health

Exploring digital health's potential role as the *foundation* of evidence-based, person-centric healthcare delivery.

Derek Ritz, P.Eng., CPHIMS-CA

IHE Netherlands Annual Conference – November 22, 2023



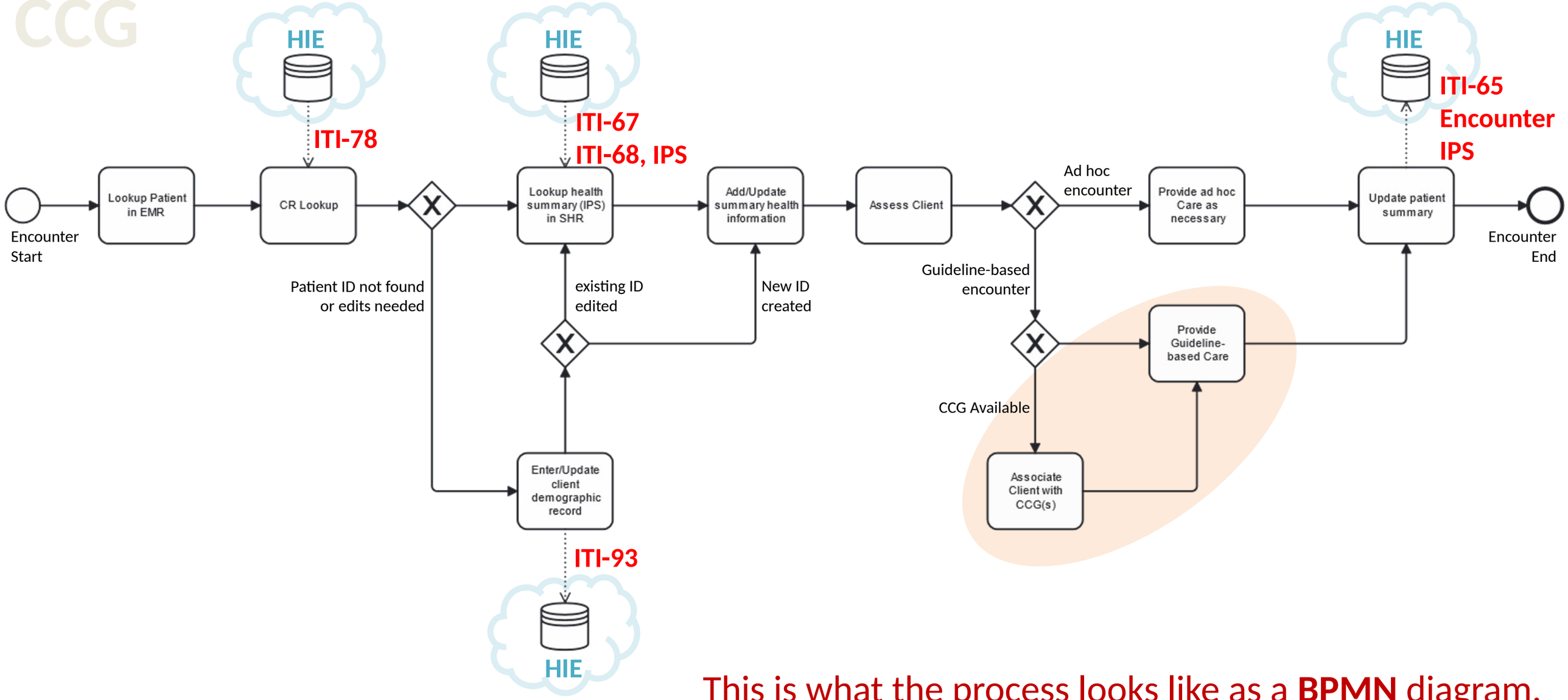
What are the “generic steps” in a ***typical*** care encounter?

Identify the patient

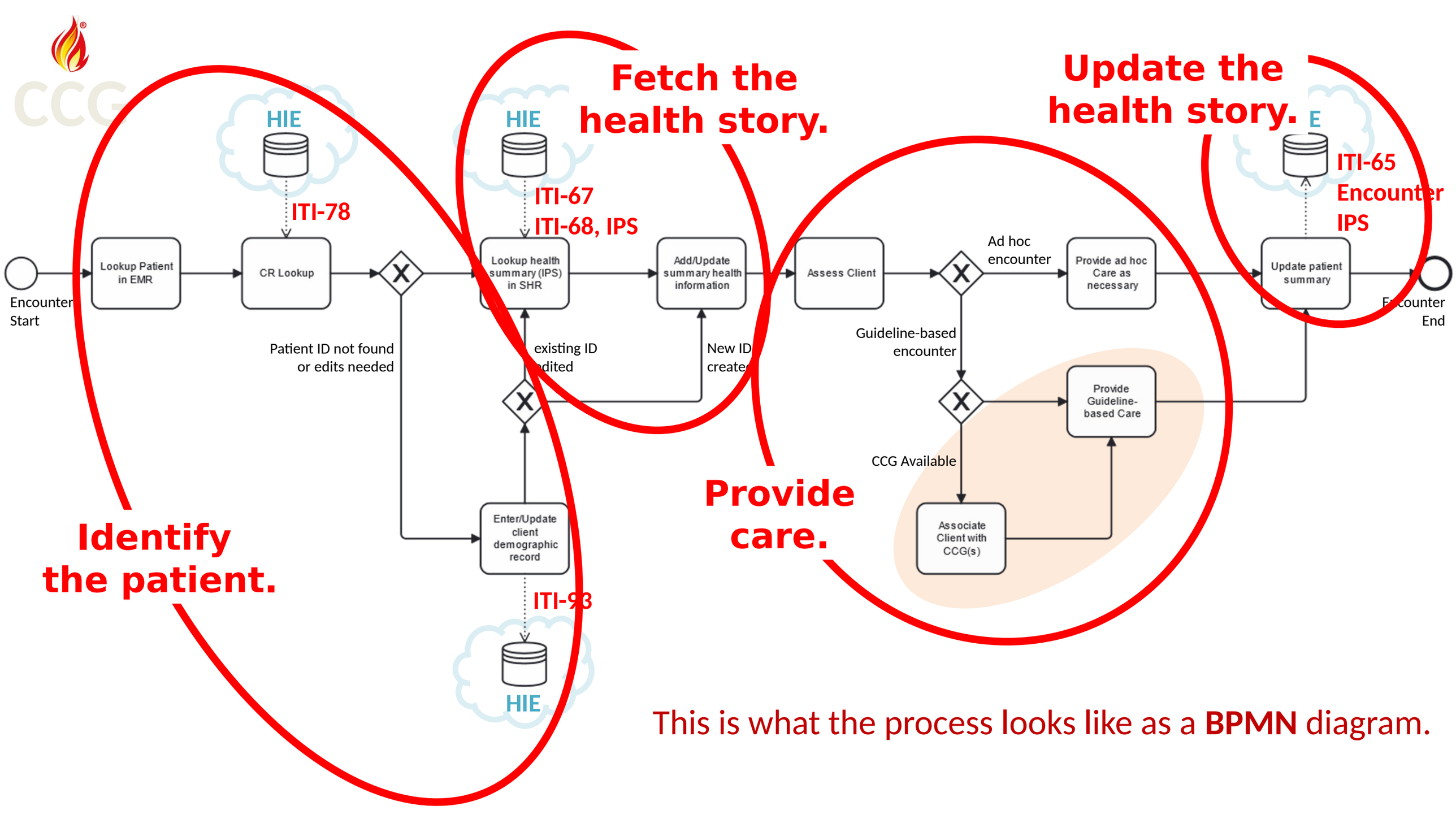
Fetch the patient’s health story

Provide guideline-based care

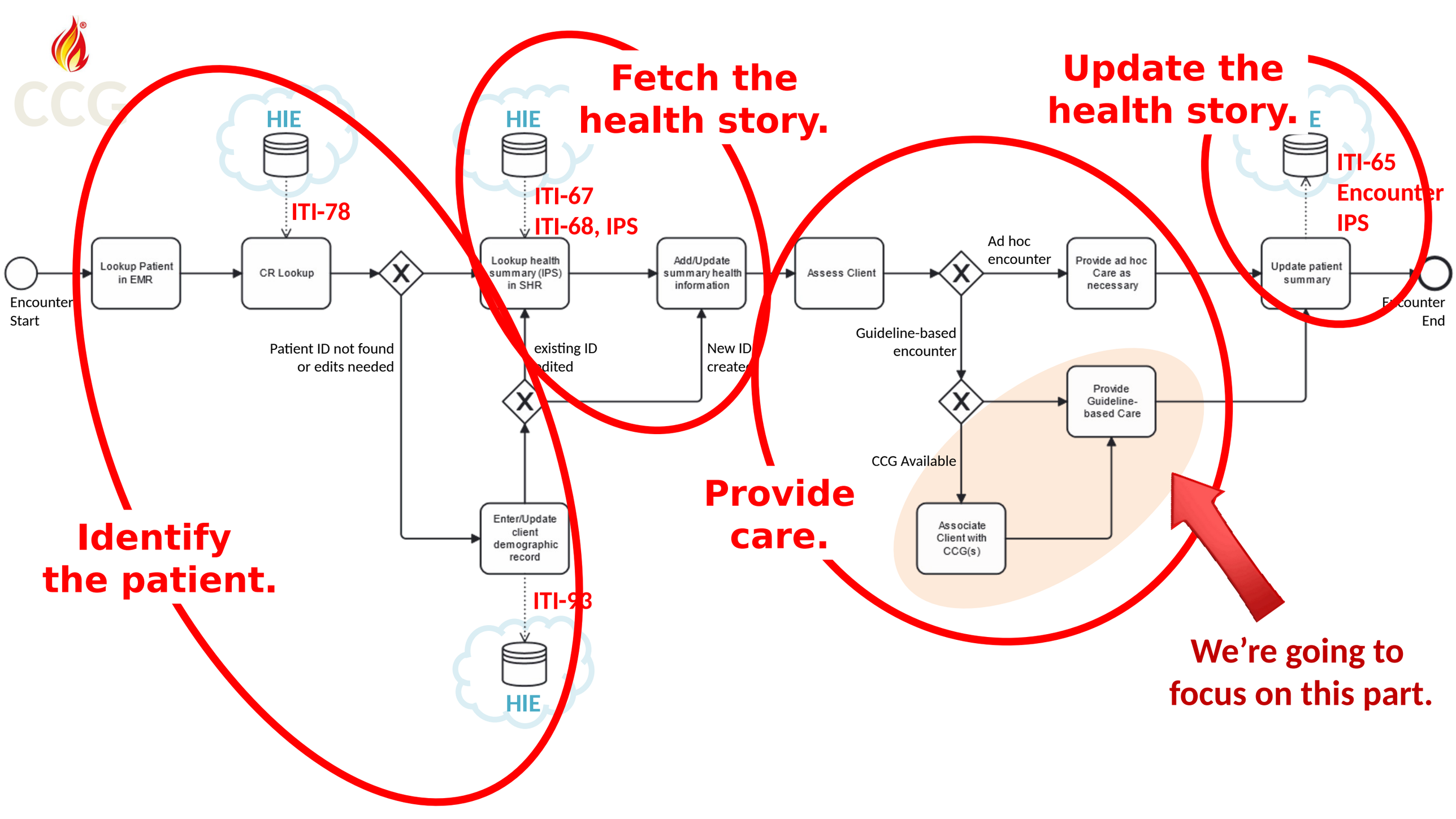
Update the patient’s health story

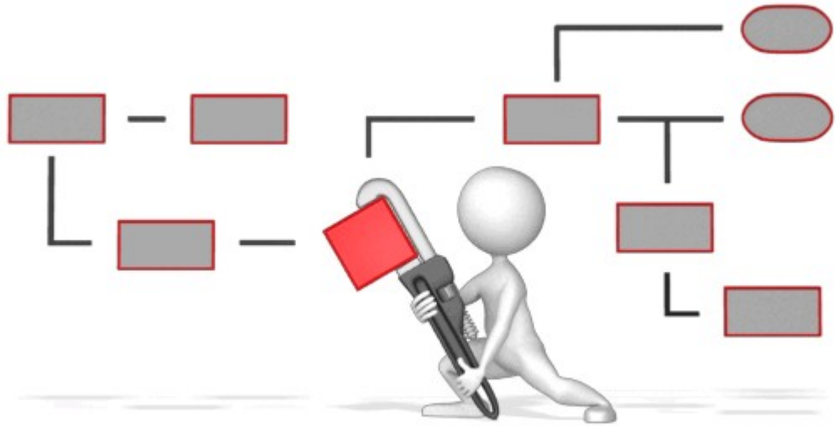


This is what the process looks like as a **BPMN** diagram.

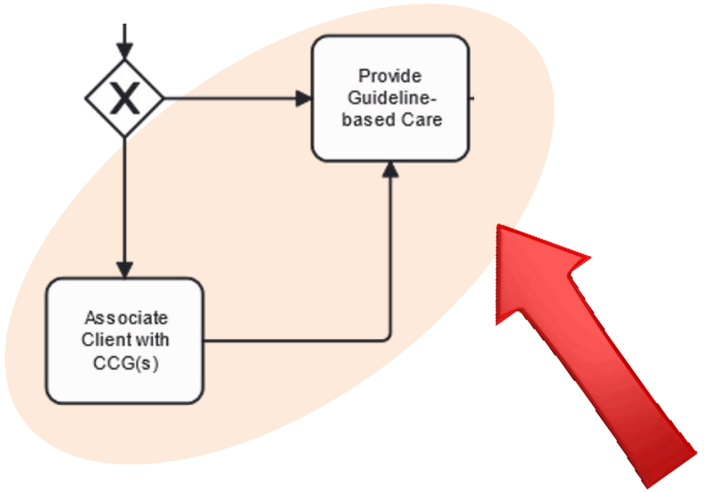


This is what the process looks like as a **BPMN** diagram.

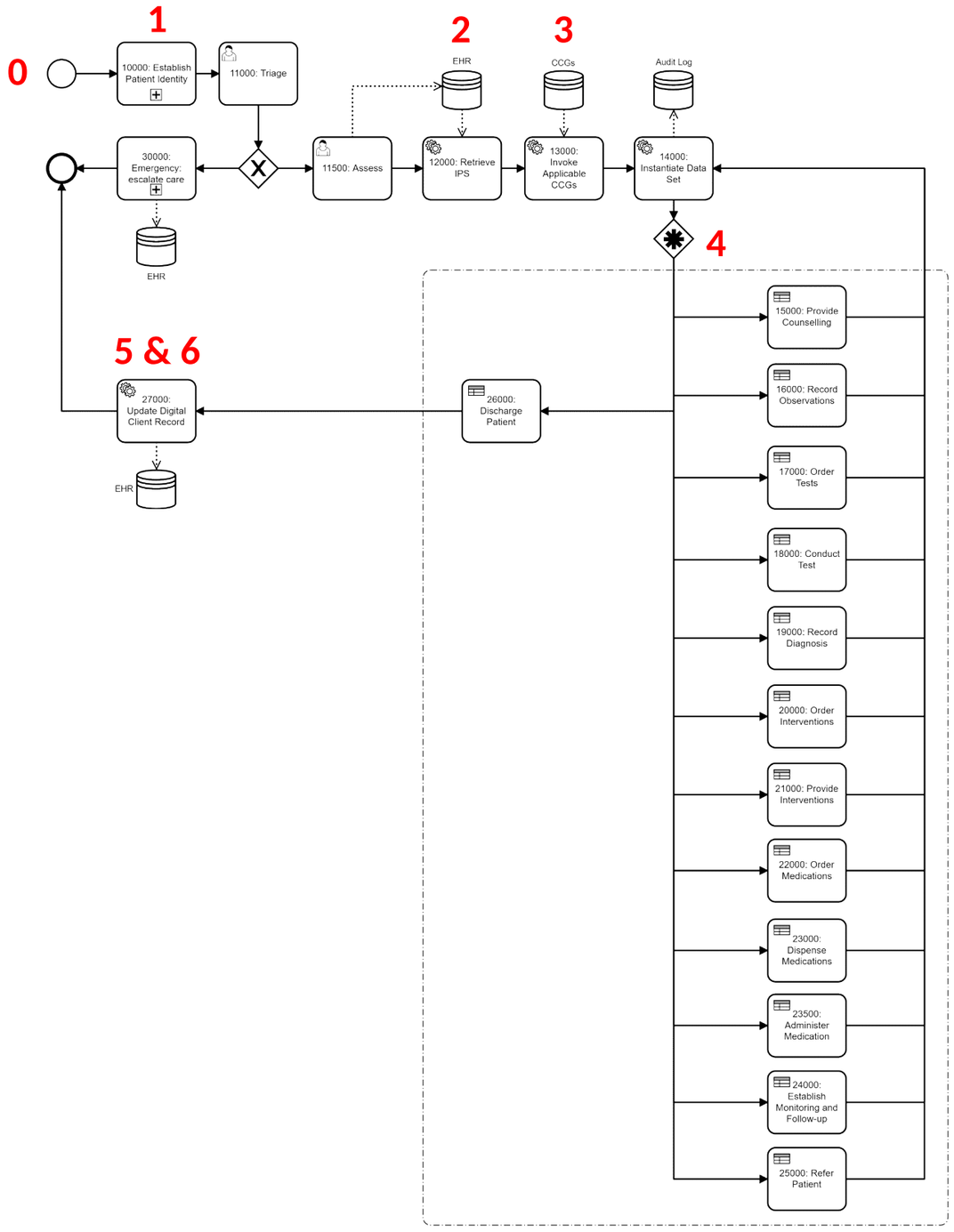

Identify the patient.
Fetch the health story.
Provide care.
Update the health story.
HIE
ITI-78
HIE
ITI-67
ITI-68, IPS
E
ITI-65
Encounter
IPS
Encounter Start
Lookup Patient in EMR
CR Lookup
Patient ID not found or edits needed
Enter/Update client demographic record
ITI-93
HIE
Lookup health summary (IPS) in SHR
existing ID edited
Add/Update summary health information
New ID create
Assess Client
Ad hoc encounter
Provide ad hoc Care as necessary
Guideline-based encounter
Provide Guideline-based Care
CCG Available
Associate Client with CCG(s)
Update patient summary
Encounter End
We're going to focus on this part.

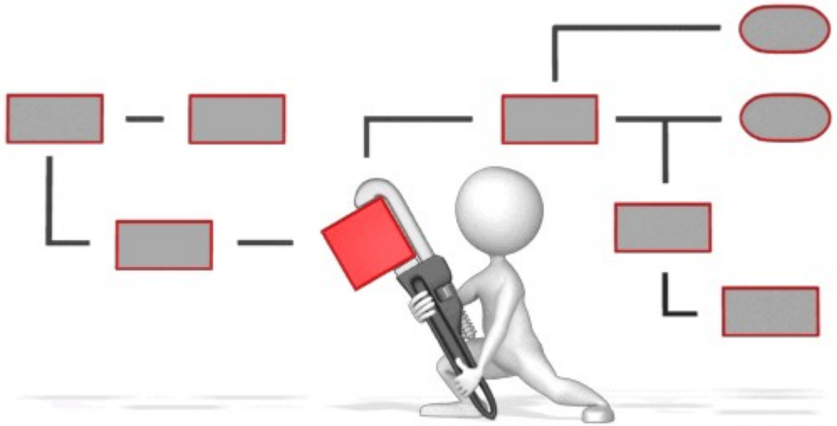


We can express the ***CCG-processing logic*** using BPMN.



We're going to focus on this part.

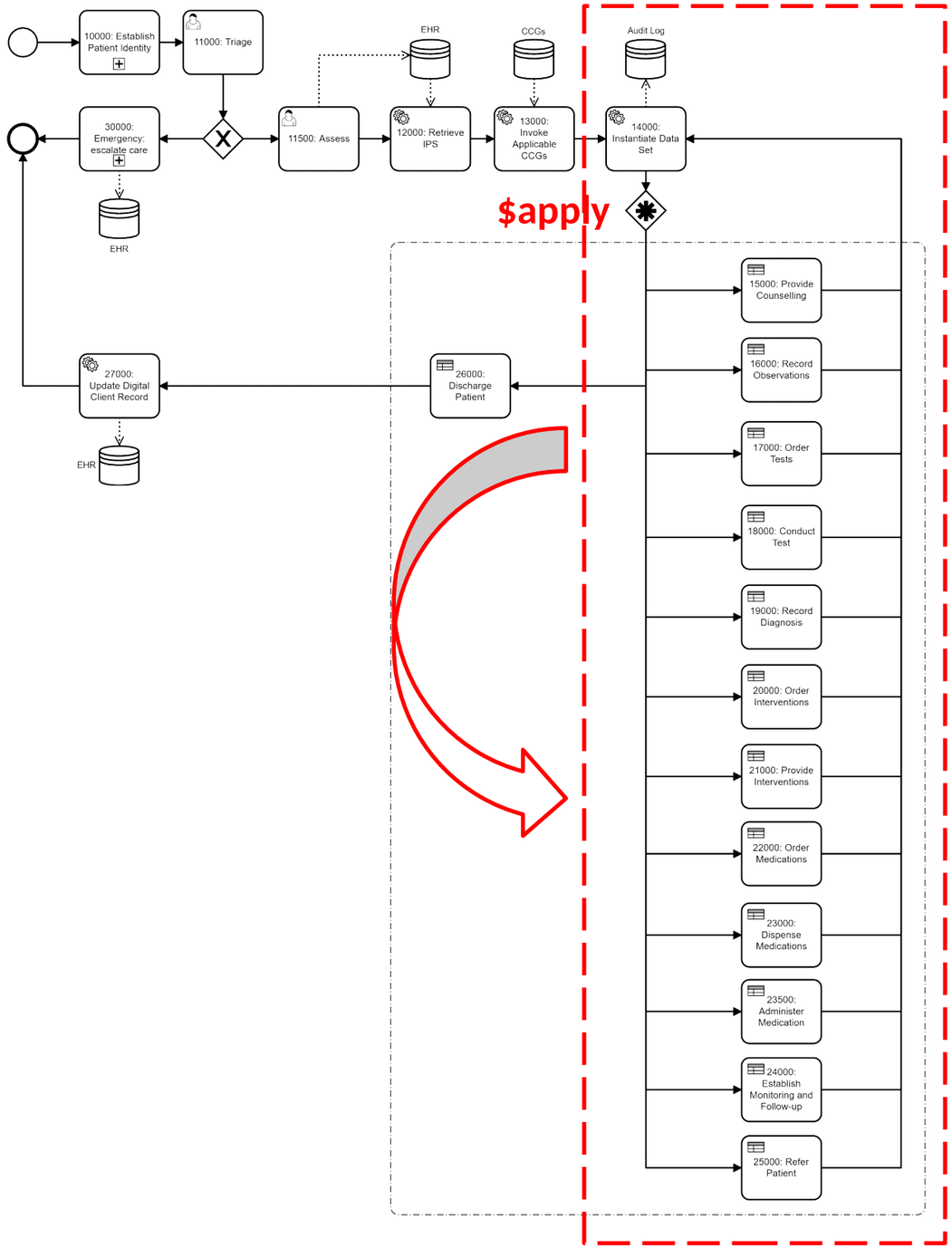


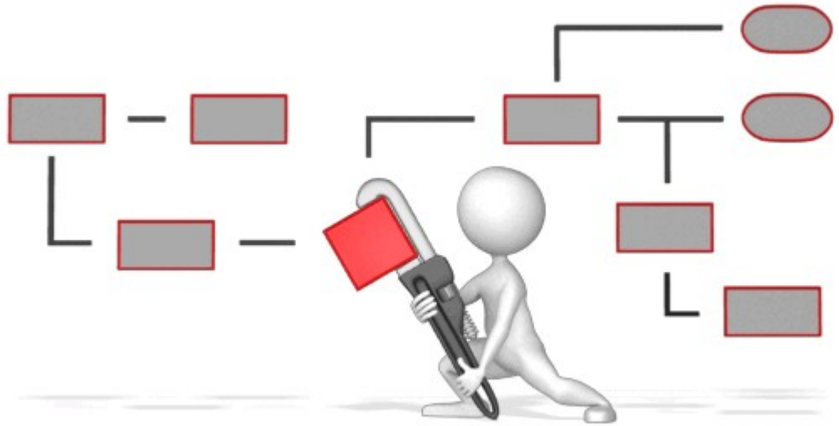


0. Establish the encounter's *context* (location, practitioner, organization, available services)

---

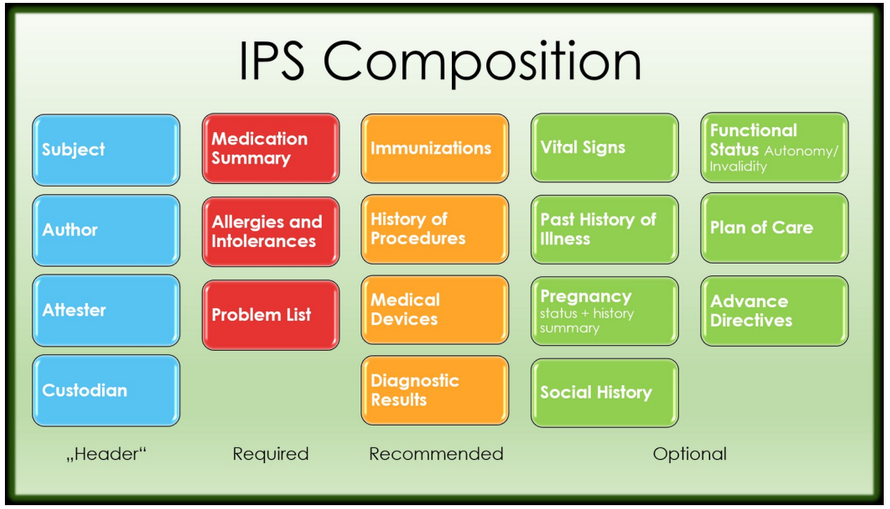
1. Identify the patient
2. Retrieve the patient's health summary
3. Retrieve the appropriate care plan(s) for the patient
4. **EXECUTE GUIDELINE-BASED CARE**
5. Update the patient's care plan
6. Update the patient's health summary





- 15000: Provide Counseling
- 16000: Record Observations
- 17000: Order Tests
- 18000: Conduct Test
- 19000: Record Diagnosis
- 20000: Order Interventions
- 21000: Provide Interventions
- 22000: Order Medications
- 23000: Dispense Medications
- 23500: Administer Medications
- 24000: Establish Monitoring and Follow-up
- 25000: Refer Patient

IPS provides the person-centric ***data model*** for CCGs.



SNOMED International

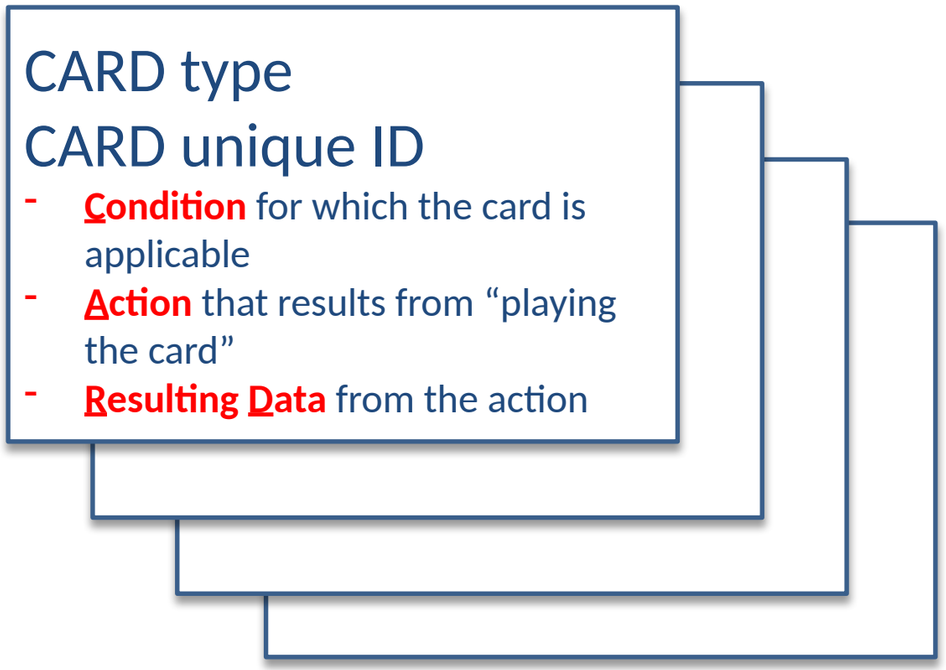
ATC/DDD

ICD-11 *

- Medication Summary (R) [Medication Statement (IPS) | Medication (IPS)]
- Allergies and Intolerances (R) [Allergy Intolerance (IPS)]
- Problem List (R) [Condition (IPS)]
- Immunizations (S) [Immunization (IPS)]
- History of Procedures (S) [Procedure (IPS) | Organization (IPS) | Device (performer, observer)]
- Medical Devices (S) [Device Use Statement (IPS) | Device (IPS)]
- Diagnostic Results (S) [Observation (Results) | DiagnosticReport (IPS) | Organization (IPS)]
  - Laboratory results [Observation (Results: laboratory) | Specimen (IPS) | Media observation (Results: laboratory, media)]
  - Radiology results [Observation (Results: radiology) | Device (performer, observer) | Imaging Study (IPS) | Practitioner (IPS)]
  - Pathology results [Observation (Results: pathology) | Specimen (IPS) | Media observation (Results: laboratory, media)]
- Vital Signs [Vital Signs]
- Past history of illnesses [Condition (IPS)]
- Pregnancy (status and history summary) [Observation (Pregnancy: EDD) | Observation (Pregnancy: outcome) | Observation (Pregnancy: status)]
- Social History [Observation (SH: alcohol use) | Observation (SH: tobacco use)]
- Functional Status (Autonomy / Invalidity) [Condition (IPS) | Clinical Impression]
- Plan of care [Care Plan]
- Advance Directives [Consent]

CCGs must be **superimposable**.
The “metaphor” is the key.

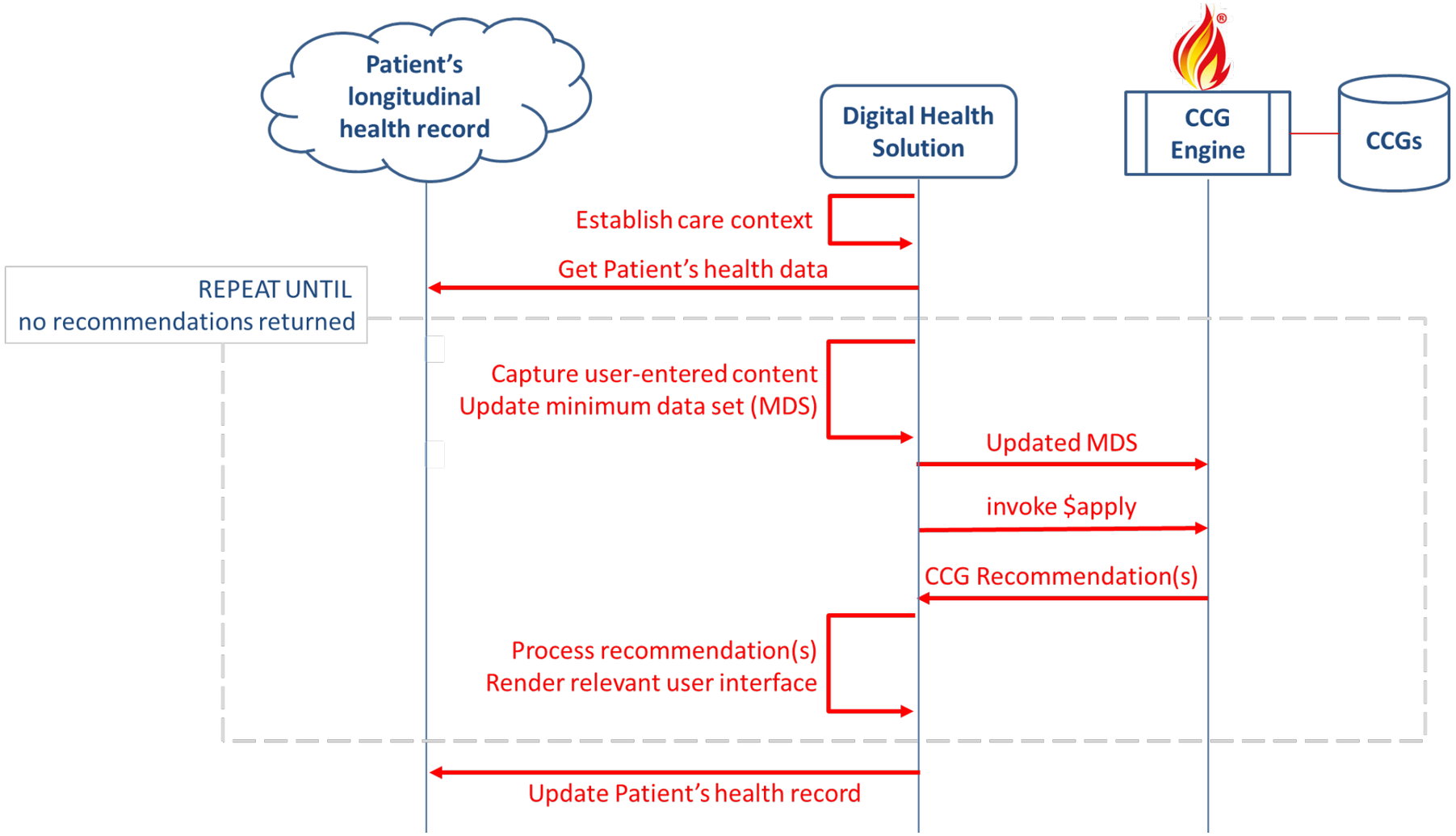
Metaphor-1: **a *folder* full of *CARDs***



One folder per care guideline
(FHIR **PlanDefinition** resource)

One card per guideline-based recommendation
(A PlanDefinition containing a single **ActivityDefinition** resource based on one of the pre-defined card "types")

Metaphor-2: ***an iterative CARD-stack processor***



ANC

C: diagnosis = currently pregnant

Condition
Action
Resulting Data

15000
GUID-1
C: at each encounter; not yet done
A: provide applicable pregnancy counseling
RD: Communication resource

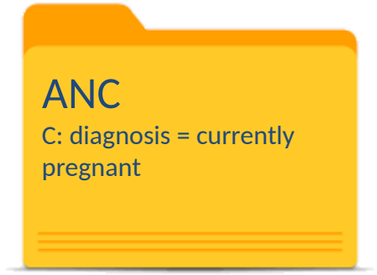
16000
GUID-2
C: at each encounter; not yet done
A: measure BP
RD: BP Observation resource

16000
GUID-3
C: at each encounter; not yet done
A: measure temperature
RD: temperature Observation resource

16000
GUID-4
C: at each encounter; not yet done
A: measure weight
RD: weight Observation resource

18000
GUID-5
C: at first ANC encounter; not yet done
A: conduct rapid HIV test
RD: lab result Observation resource

22000
GUID-8
C: if BP>target and not BP meds dispensed
A: prescribe BP meds
RD: BP MedicationRequest resource



Condition
Action
Resulting Data

15000
GUID-1
C: at each encounter; not yet done
A: provide applicable pregnancy counseling
RD: Communication resource

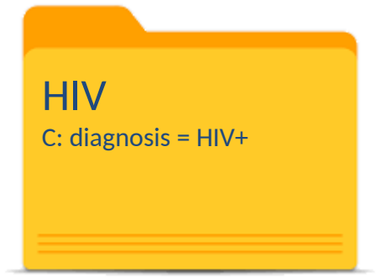
16000
GUID-2
C: at each encounter; not yet done
A: measure BP
RD: BP Observation resource

16000
GUID-3
C: at each encounter; not yet done
A: measure temperature
RD: temperature Observation

16000
GUID-4
C: at each encounter; not yet done
A: measure weight
RD: weight Observation resource

18000
GUID-5
C: at first ANC encounter; not yet done
A: conduct rapid HIV test
RD: lab result Observation resource

22000
GUID-8
C: if BP>target and not BP meds dispensed
A: prescribe BP meds
RD: BP MedicationRequest resource



Condition
Action
Resulting Data

15000
GUID-20
C: at each encounter; not yet done
A: provide applicable HIV counseling
RD: Communication resource

16000
GUID-2
C: at each encounter; not yet done
A: measure BP
RD: BP Observation resource

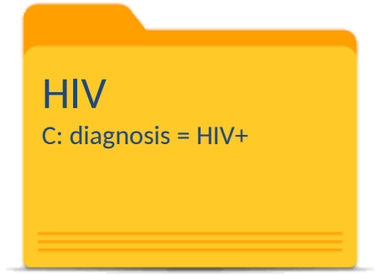
16000
GUID-4
C: at each encounter; not yet done
A: measure weight
RD: weight Observation resource

16000
GUID-22
C: at each encounter; not yet done
A: measure heart rate
RD: heart rate Observation resource

17000
GUID-24
C: if >6mo since last viral load test and no active viral load test order
A: order viral load test
RD: ServiceRequest for lab test

22000
GUID-26
C: if current date >= last ARV dispense date + coverage period
A: prescribe ARV
RD: ARV MedicationRequest resource

21000
GUID-31
C: if currently pregnant and not already PMTCT
A: provide PMTCT
RD: PMTCT service bundle order



Condition
Action
Resulting Data

15000
GUID-20
C: at each encounter; not yet done
A: provide applicable HIV counseling
RD: Communication resource

16000
GUID-2
C: at each encounter; not yet done
A: measure BP
RD: BP Observation resource

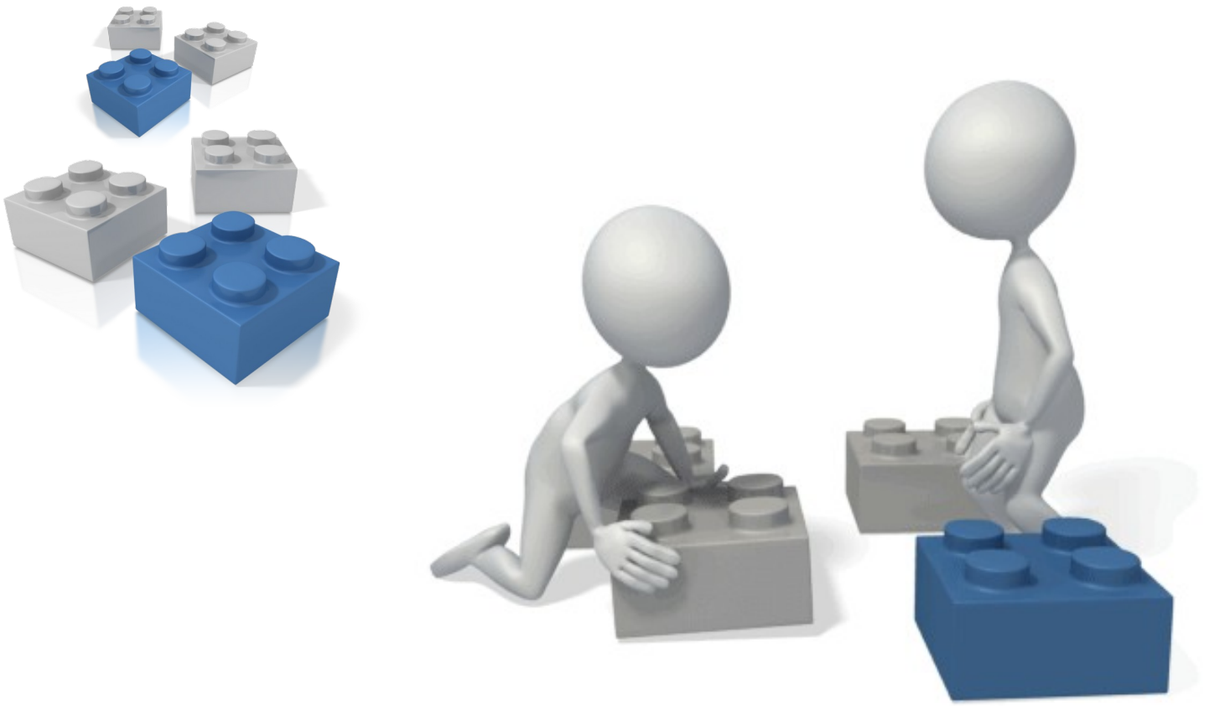
16000
GUID-4
C: at each encounter; not yet done
A: measure weight
RD: weight Observation resource

16000
GUID-22
C: at each encounter; not yet done
A: measure heart rate
RD: heart rate Observation resource

17000
GUID-24
C: if >6mo since last viral load test
and no active viral load test order
A: order viral load test
RD: ServiceRequest for lab test

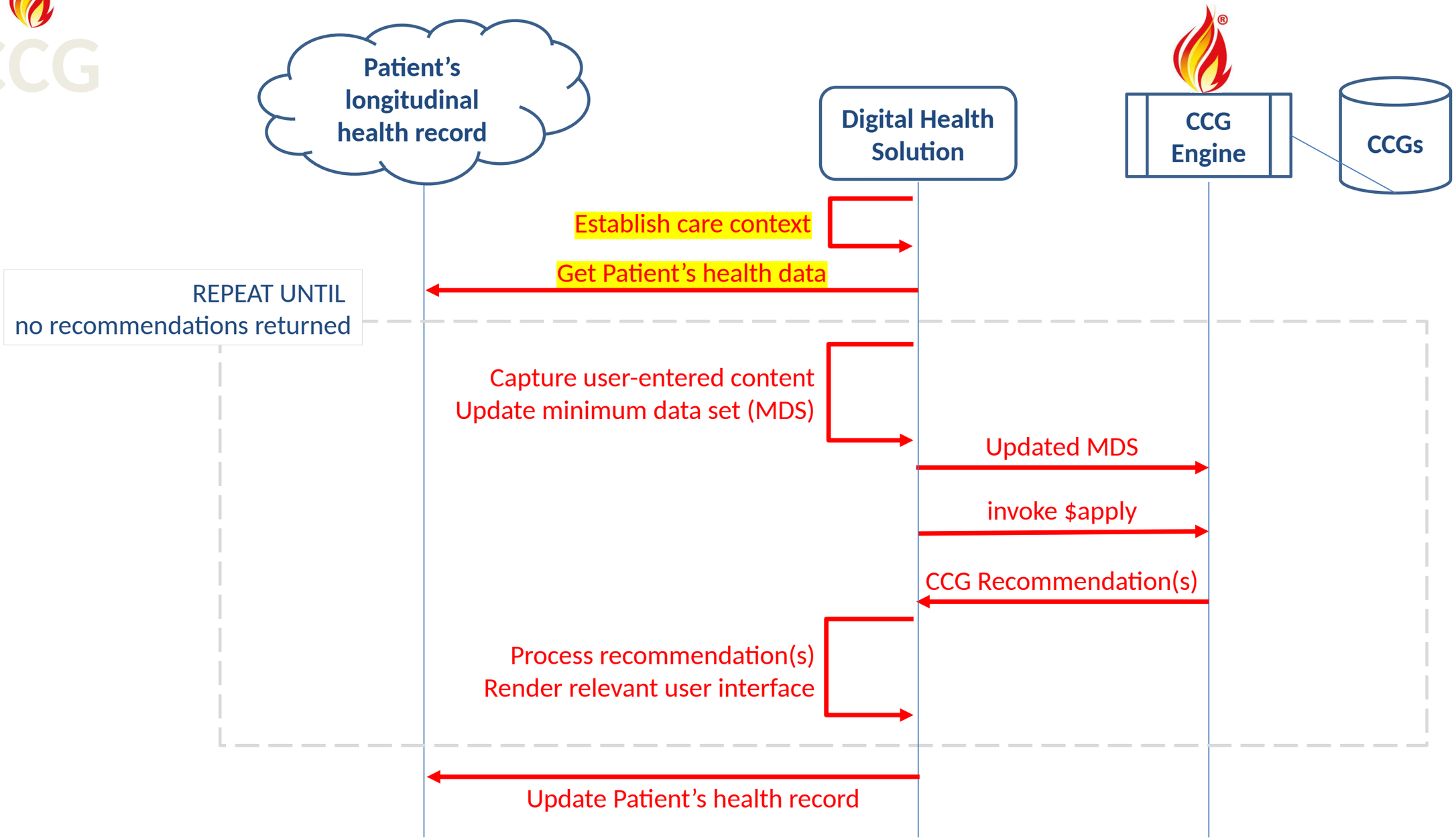
17000
GUID-24
C: if >6mo since last viral load test
and no active viral load test order
A: order viral load test
RD: ServiceRequest for lab test

• • •



A super-quick illustrative example.

Mosa is **pregnant**. She presents (4 weeks late) for her 2nd **ANC visit**.
She was given an HIV test at her first visit… she is **HIV+**.
She has been placed on **PMTCT** and is receiving **ARV** medications.


Patient's longitudinal health record
Digital Health Solution
CCG Engine
CCGs
Establish care context
Get Patient's health data
REPEAT UNTIL
no recommendations returned
Capture user-entered content
Update minimum data set (MDS)
Updated MDS
invoke $apply
CCG Recommendation(s)
Process recommendation(s)
Render relevant user interface
Update Patient's health record

IPS for this subject of care

- **Diagnosis of currently pregnant, 2 months ago**
- **HIV test observation, 2 months ago, HIV+**
- PMTCT intervention, 2 months ago
- BP 110/70, 2 months ago
- Weight 50kg, 14 months ago
- Weight 55kg, 2 months ago
- Heart rate 60, 14 months ago
- Heart rate 61, 2 months ago
- Temperature 37C, 14 months ago
- Temperature 37C, 2 months ago
- Pregnancy counseling given, 2 months ago
- **ARV dispensed, 2 months ago, 2-month supply**
- Viral load ordered, 2 months ago
- Viral load result, 6 weeks ago, 9000 copies

IPS for this subject of care

ANC

C: diagnosis = currently pregnant

HIV

C: diagnosis = HIV+

IPS for this subject of care

ANC
C: diagnosis = currently pregnant

HIV
C: diagnosis = HIV+

15000
GUID-1
C: at each encounter; not yet done
A: provide applicable pregnancy counseling
RD: Communication resource

15000
GUID-20
C: at each encounter; not yet done
A: provide applicable HIV counseling
RD: Communication resource

16000
GUID-2
C: at each encounter; not yet done
A: measure BP
RD: BP Observation resource

16000
GUID-3
C: at each encounter; not yet done
A: measure temperature
RD: temperature Observation resource

16000
GUID-4
C: at each encounter; not yet done
A: measure weight
RD: weight Observation resource

16000
GUID-22
C: at each encounter; not yet done
A: measure heart rate
RD: heart rate Observation resource

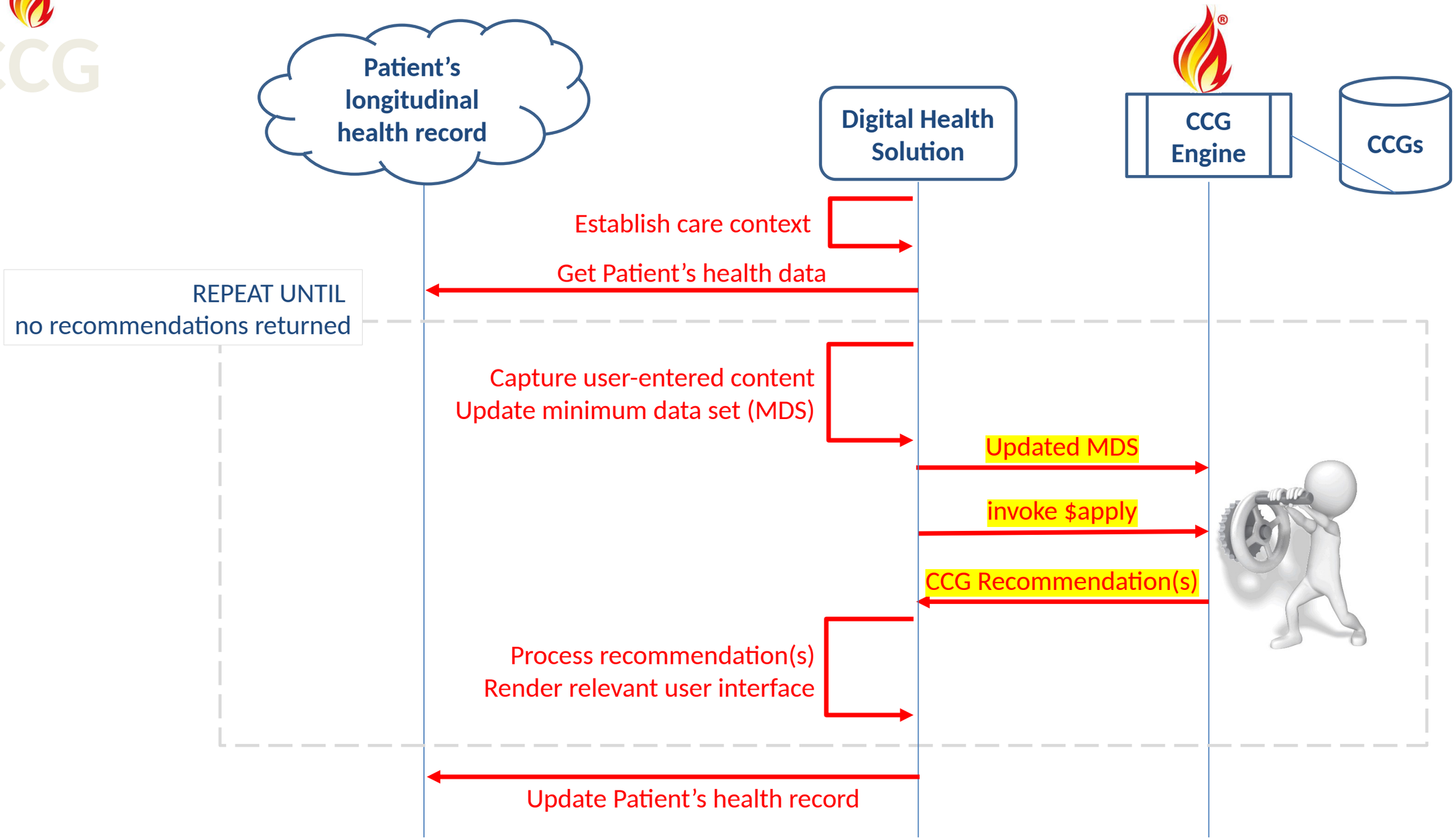
17000
GUID-24
C: if >6mo since last viral load test and no active viral load test order
A: order viral load test
RD: ServiceRequest for lab test

18000
GUID-5
C: at first ANC encounter; not yet done
A: conduct rapid HIV test
RD: lab result Observation resource

21000
GUID-31
C: if currently pregnant and not already PMTCT
A: provide PMTCT
RD: PMTCT service bundle order

22000
GUID-8
C: if BP>target and not BP meds dispensed
A: prescribe BP meds
RD: BP medication order resource

22000
GUID-26
C: if current date >= last ARV dispense date + coverage period
A: prescribe ARV
RD: ARV med order resource


Patient's longitudinal health record
Digital Health Solution
CCG Engine
CCGs
Establish care context
Get Patient's health data
REPEAT UNTIL
no recommendations returned
Capture user-entered content
Update minimum data set (MDS)
Updated MDS
invoke $apply
CCG Recommendation(s)
Process recommendation(s)
Render relevant user interface
Update Patient's health record

IPS for this subject of care

15000
GUID-1
C: at each encounter; not yet done
A: provide applicable pregnancy counseling
RD: Communication resource

15000
GUID-20
C: at each encounter; not yet done
A: provide applicable HIV counseling
RD: Communication resource

16000
GUID-2
C: at each encounter; not yet done
A: measure BP
RD: BP Observation resource

16000
GUID-3
C: at each encounter; not yet done
A: measure temperature
RD: temperature Observation resource

16000
GUID-4
C: at each encounter; not yet done
A: measure weight
RD: weight Observation resource

16000
GUID-22
C: at each encounter; not yet done
A: measure heart rate
RD: heart rate Observation resource

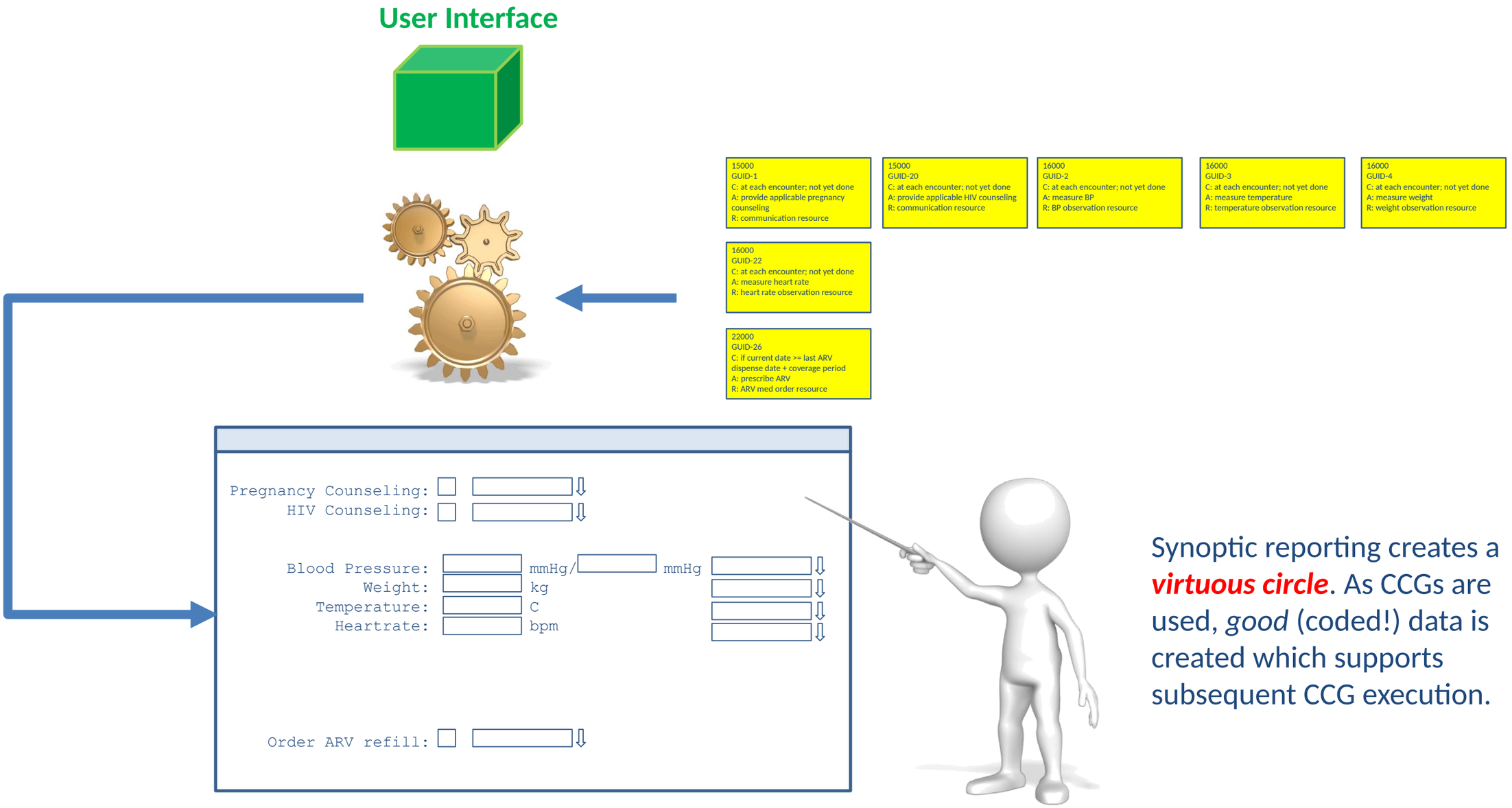
17000
GUID-24
C: if >6mo since last viral load test and no active viral load test order
A: order viral load test
RD: ServiceRequest for lab test

18000
GUID-5
C: at first ANC encounter; not yet done
A: conduct rapid HIV test
RD: lab result Observation resource

21000
GUID-31
C: if currently pregnant and not already PMTCT
A: provide PMTCT
RD: PMTCT service bundle order

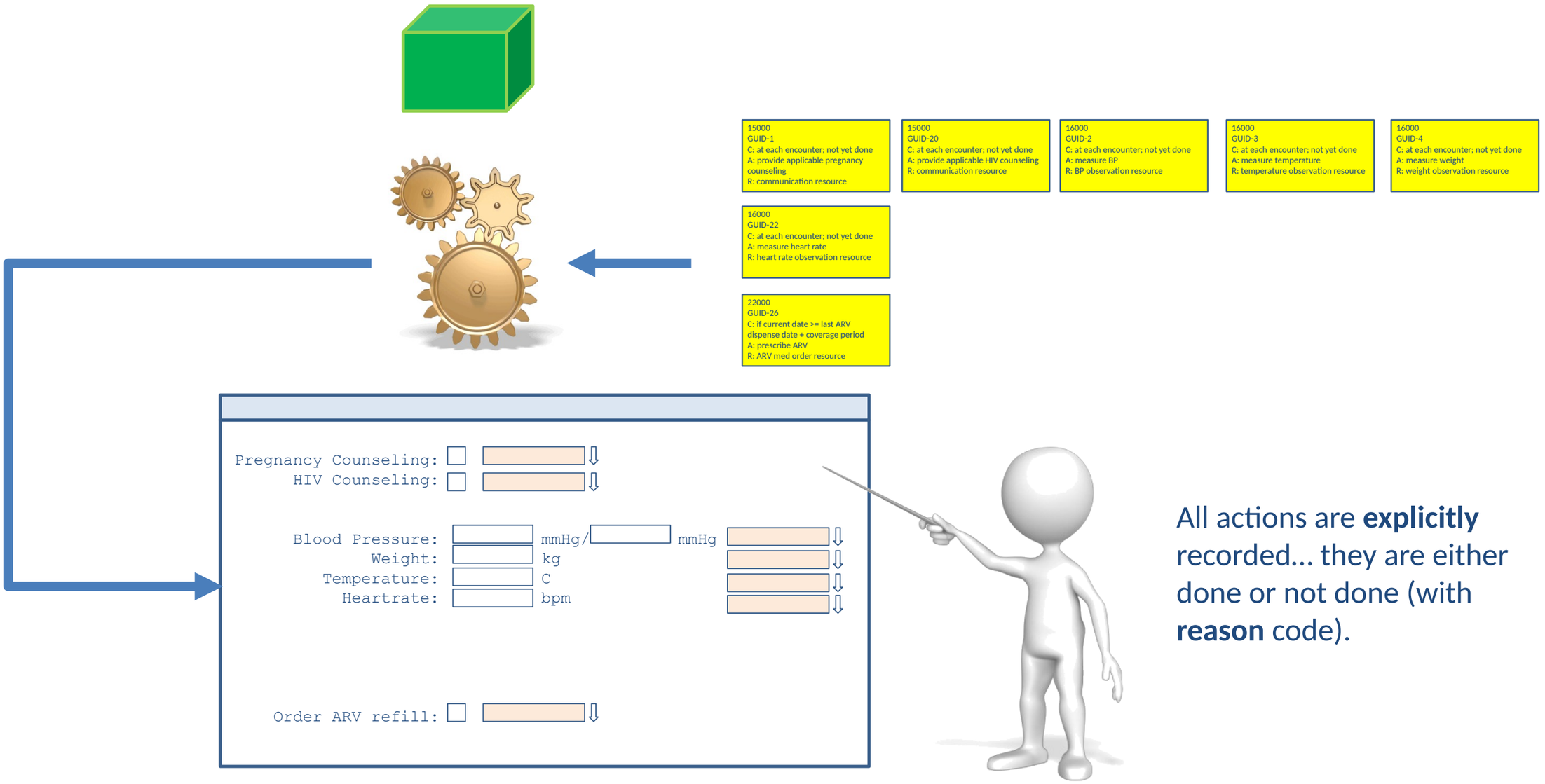
22000
GUID-8
C: if BP>target and not BP meds dispensed
A: prescribe BP meds
RD: BP medication order resource

22000
GUID-26
C: if current date >= last ARV dispense date + coverage period
A: prescribe ARV
RD: ARV med order resource



Synoptic reporting creates a ***virtuous circle***. As CCGs are used, *good* (coded!) data is created which supports subsequent CCG execution.

User Interface



All actions are **explicitly** recorded… they are either done or not done (with **reason** code).

IPS for this subject of care

Pregnancy counseling given now

BP observation now, 150/90

weight observation now, 59kg

ARV meds order, now

HIV counseling given now

temperature observation now, 37C

Heart rate observation now, 61

15000
GUID-1
C: at each encounter; not yet done
A: provide applicable pregnancy counseling
RD: Communication resource

15000
GUID-20
C: at each encounter; not yet done
A: provide applicable HIV counseling
RD: Communication resource

16000
GUID-2
C: at each encounter; not yet done
A: measure BP
RD: BP Observation resource

16000
GUID-3
C: at each encounter; not yet done
A: measure temperature
RD: temperature Observation resource

16000
GUID-4
C: at each encounter; not yet done
A: measure weight
RD: weight Observation resource

16000
GUID-22
C: at each encounter; not yet done
A: measure heart rate
RD: heart rate Observation resource

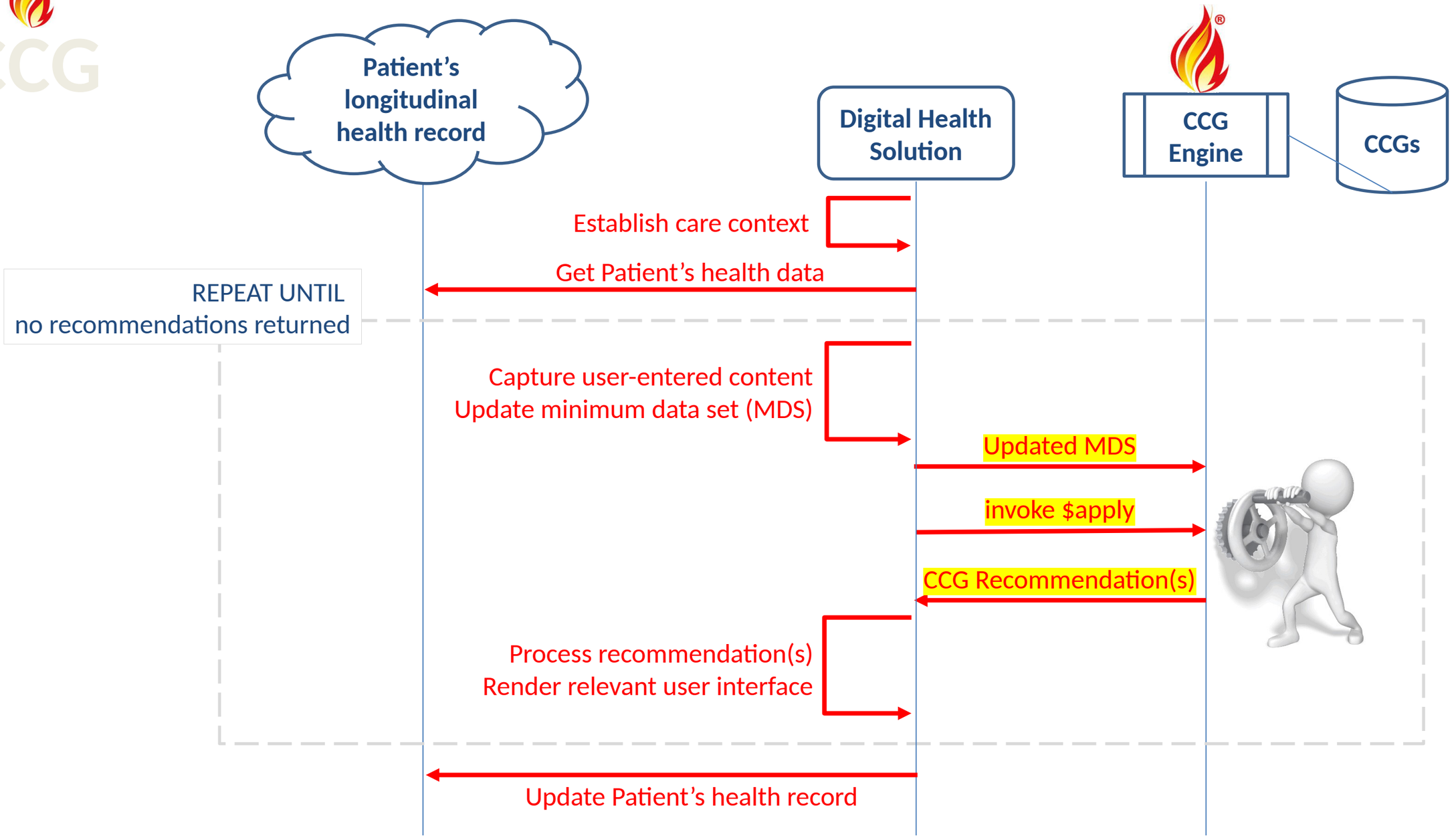
17000
GUID-24
C: if >6mo since last viral load test and no active viral load test order
A: order viral load test
RD: ServiceRequest for lab test

18000
GUID-5
C: at first ANC encounter; not yet done
A: conduct rapid HIV test
RD: lab result Observation resource

21000
GUID-31
C: if currently pregnant and not already PMTCT
A: provide PMTCT
RD: PMTCT service bundle order

22000
GUID-8
C: if BP>target and not BP meds dispensed
A: prescribe BP meds
RD: BP medication order resource

22000
GUID-26
C: if current date >= last ARV dispense date + coverage period
A: prescribe ARV
RD: ARV med order resource


Patient's longitudinal health record
Digital Health Solution
CCG Engine
CCGs
Establish care context
Get Patient's health data
REPEAT UNTIL
no recommendations returned
Capture user-entered content
Update minimum data set (MDS)
Updated MDS
invoke $apply
CCG Recommendation(s)
Process recommendation(s)
Render relevant user interface
Update Patient's health record

IPS for this subject of care

BP observation now, 150/90

15000
GUID-1
C: at each encounter; not yet done
A: provide applicable pregnancy counseling
RD: Communication resource

15000
GUID-20
C: at each encounter; not yet done
A: provide applicable HIV counseling
RD: Communication resource

16000
GUID-2
C: at each encounter; not yet done
A: measure BP
RD: BP Observation resource

16000
GUID-3
C: at each encounter; not yet done
A: measure temperature
RD: temperature Observation resource

16000
GUID-4
C: at each encounter; not yet done
A: measure weight
RD: weight Observation resource

16000
GUID-22
C: at each encounter; not yet done
A: measure heart rate
RD: heart rate Observation resource

17000
GUID-24
C: if >6mo since last viral load test and no active viral load test order
A: order viral load test
RD: ServiceRequest for lab test

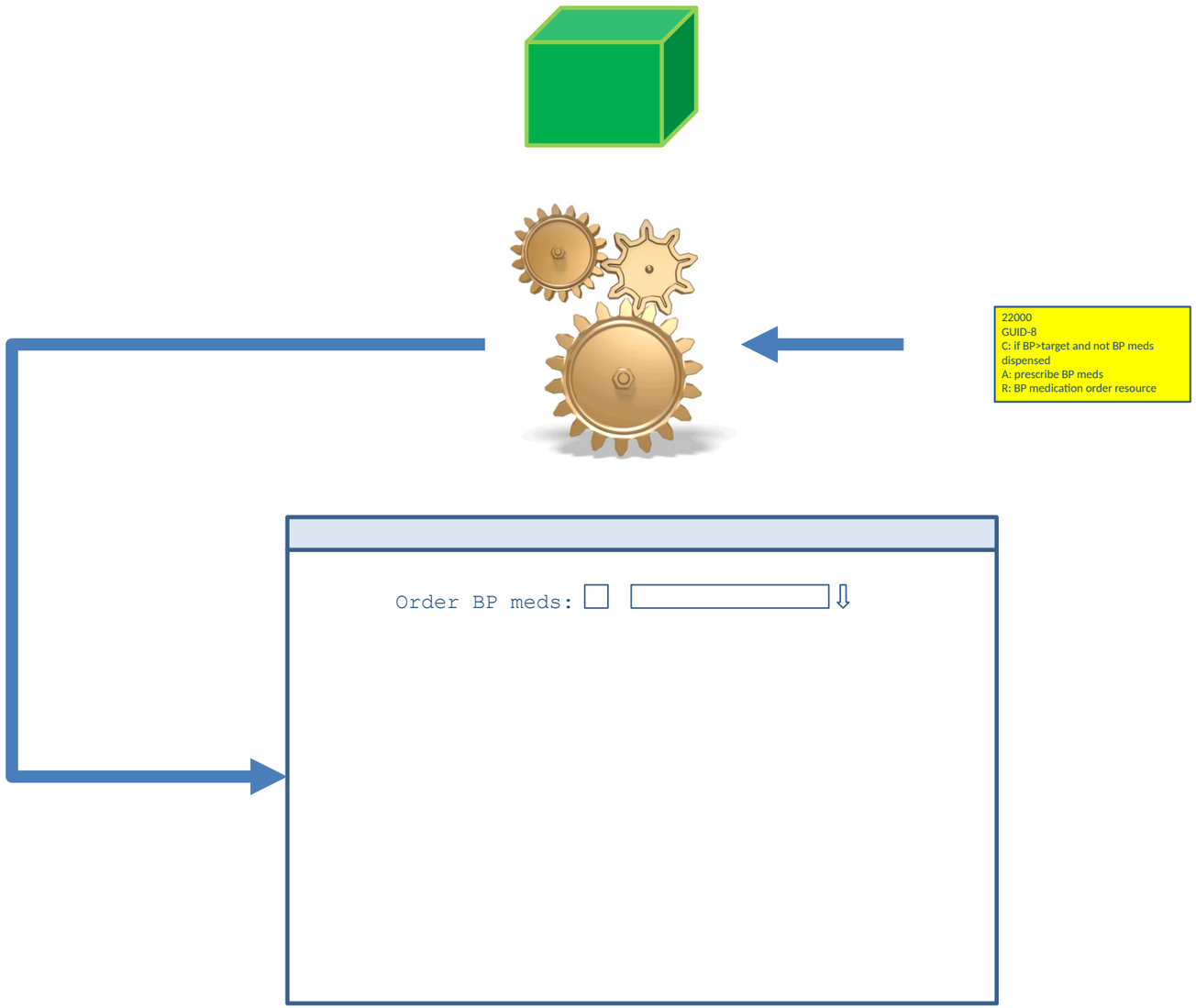
18000
GUID-5
C: at first ANC encounter; not yet done
A: conduct rapid HIV test
RD: lab result Observation resource

21000
GUID-31
C: if currently pregnant and not already PMTCT
A: provide PMTCT
RD: PMTCT service bundle order

22000
GUID-8
C: if BP>target and not BP meds dispensed
A: prescribe BP meds
RD: BP medication order resource

22000
GUID-26
C: if current date >= last ARV dispense date + coverage period
A: prescribe ARV
RD: ARV med order resource

User Interface



IPS for this subject of care

BP meds ordered, now

15000
GUID-1
C: at each encounter; not yet done
A: provide applicable pregnancy counseling
RD: Communication resource

15000
GUID-20
C: at each encounter; not yet done
A: provide applicable HIV counseling
RD: Communication resource

16000
GUID-2
C: at each encounter; not yet done
A: measure BP
RD: BP Observation resource

16000
GUID-3
C: at each encounter; not yet done
A: measure temperature
RD: temperature Observation resource

16000
GUID-4
C: at each encounter; not yet done
A: measure weight
RD: weight Observation resource

16000
GUID-22
C: at each encounter; not yet done
A: measure heart rate
RD: heart rate Observation resource

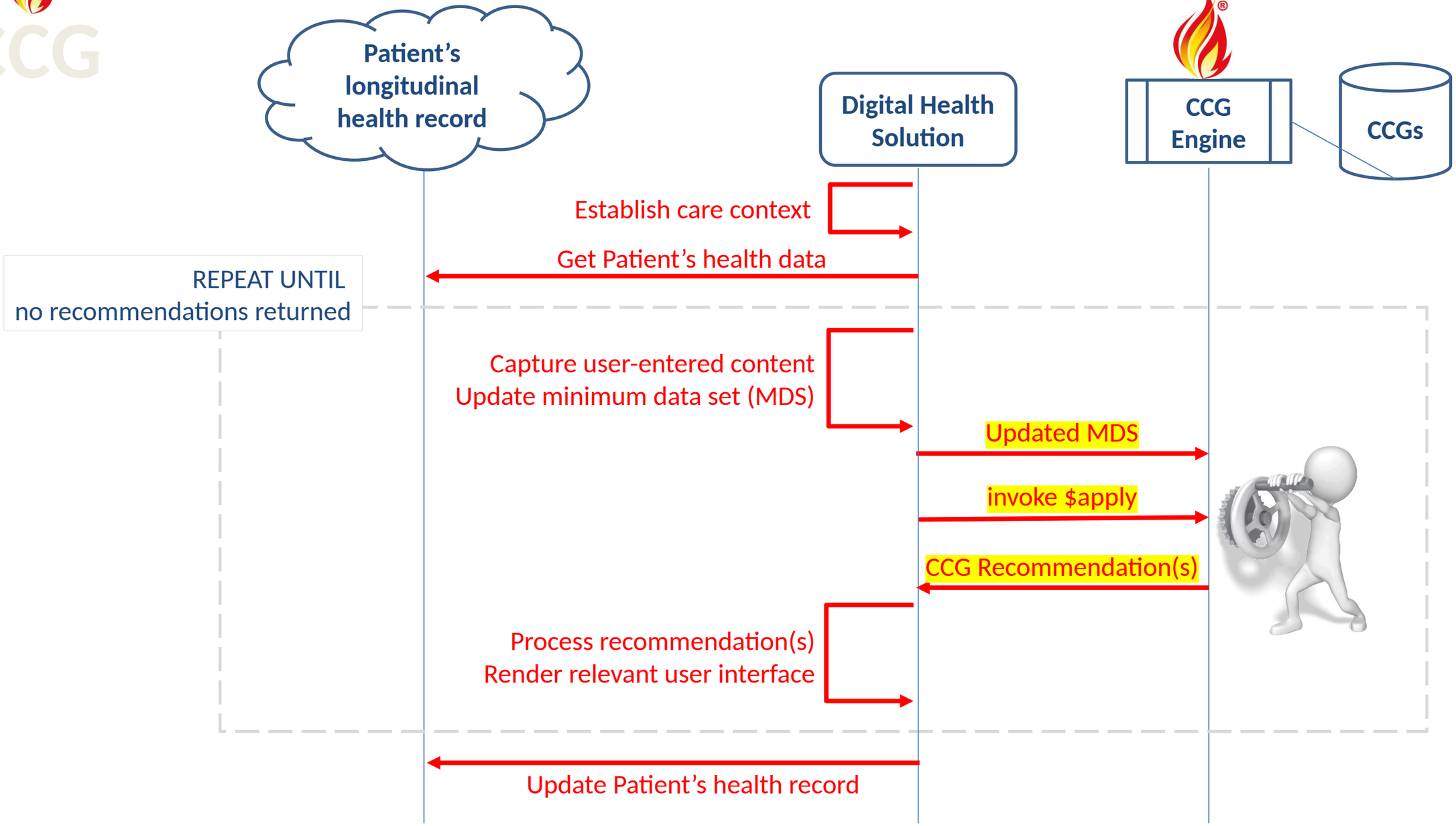
17000
GUID-24
C: if >6mo since last viral load test and no active viral load test order
A: order viral load test
RD: ServiceRequest for lab test

18000
GUID-5
C: at first ANC encounter; not yet done
A: conduct rapid HIV test
RD: lab result Observation resource

21000
GUID-31
C: if currently pregnant and not already PMTCT
A: provide PMTCT
RD: PMTCT service bundle order

22000
GUID-8
C: if BP>target and not BP meds dispensed
A: prescribe BP meds
RD: BP medication order resource

22000
GUID-26
C: if current date >= last ARV dispense date + coverage period
A: prescribe ARV
RD: ARV med order resource


Patient's longitudinal health record
Digital Health Solution
CCG Engine
CCGs
Establish care context
Get Patient's health data
REPEAT UNTIL
no recommendations returned
Capture user-entered content
Update minimum data set (MDS)
Updated MDS
invoke $apply
CCG Recommendation(s)
Process recommendation(s)
Render relevant user interface
Update Patient's health record

IPS for this subject of care

No cards evaluated TRUE.
We're **DONE**!

15000
GUID-1
C: at each encounter; not yet done
A: provide applicable pregnancy counseling
RD: Communication resource

15000
GUID-20
C: at each encounter; not yet done
A: provide applicable HIV counseling
RD: Communication resource

16000
GUID-2
C: at each encounter; not yet done
A: measure BP
RD: BP Observation resource

16000
GUID-3
C: at each encounter; not yet done
A: measure temperature
RD: temperature Observation resource

16000
GUID-4
C: at each encounter; not yet done
A: measure weight
RD: weight Observation resource

16000
GUID-22
C: at each encounter; not yet done
A: measure heart rate
RD: heart rate Observation resource

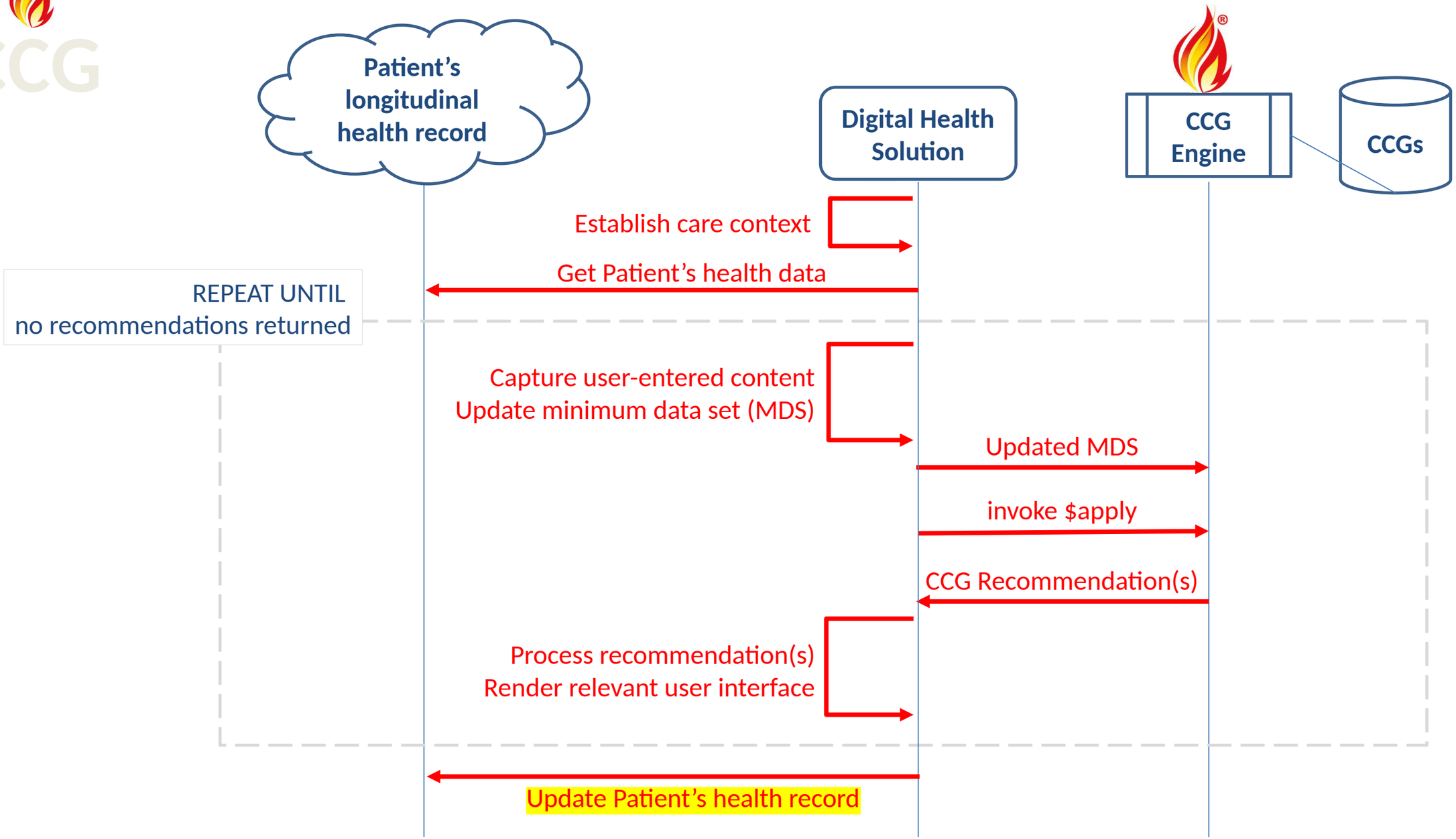
17000
GUID-24
C: if >6mo since last viral load test and no active viral load test order
A: order viral load test
RD: ServiceRequest for lab test

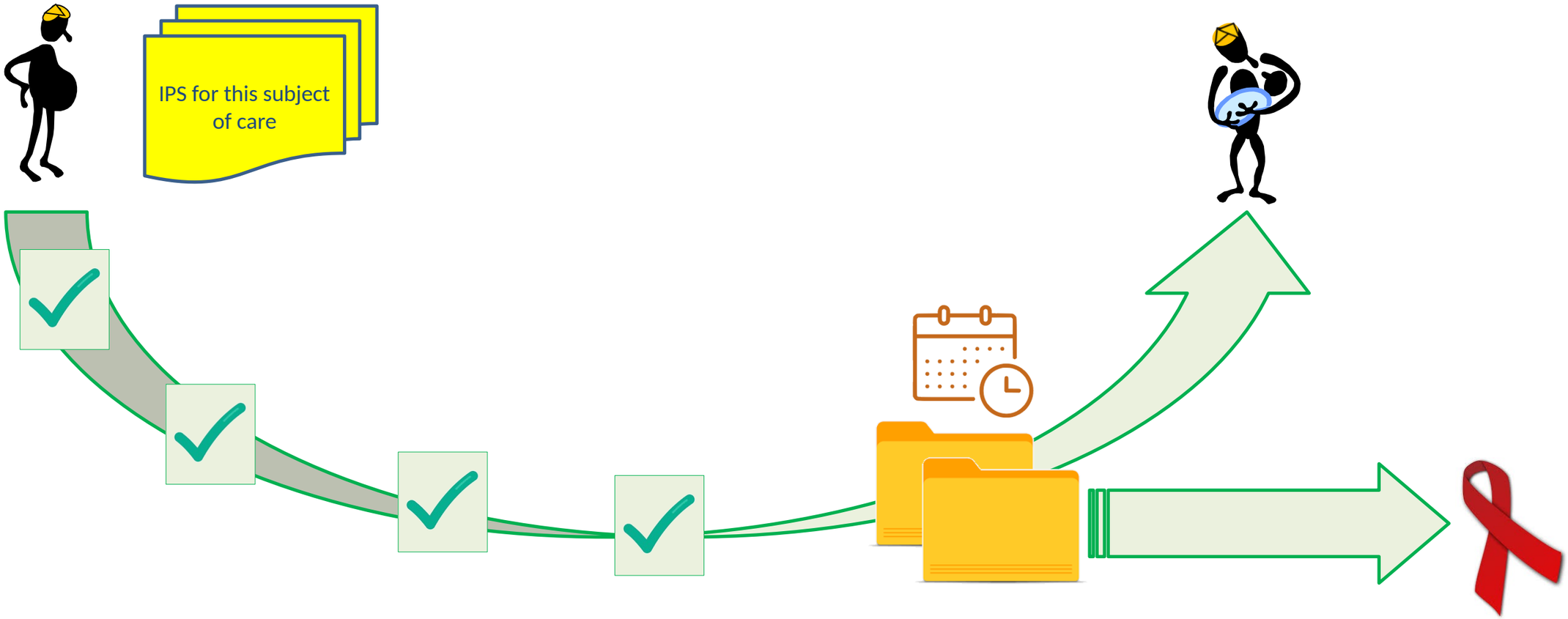
18000
GUID-5
C: at first ANC encounter; not yet done
A: conduct rapid HIV test
RD: lab result Observation resource

21000
GUID-31
C: if currently pregnant and not already PMTCT
A: provide PMTCT
RD: PMTCT service bundle order

22000
GUID-8
C: if BP>target and not BP meds dispensed
A: prescribe BP meds
RD: BP medication order resource

22000
GUID-26
C: if current date >= last ARV dispense date + coverage period
A: prescribe ARV
RD: ARV med order resource


Patient's longitudinal health record
Digital Health Solution
CCG Engine
CCGs
Establish care context
Get Patient's health data
REPEAT UNTIL
no recommendations returned
Capture user-entered content
Update minimum data set (MDS)
Updated MDS
invoke $apply
CCG Recommendation(s)
Process recommendation(s)
Render relevant user interface
Update Patient's health record



Each guideline-based encounter is part of a long-running care path.

Important **simplifications**…

The encounter ***context*** must be established prior to CCG execution (location, provider, date & time, etc.)

CCG ***condition*** statements must be defined in terms of the **IHE mCSD** (context) and **IHE IPS** (clinical) data content models

CCG ***actions*** must be defined in terms of one of the pre-defined “CARD” types

Reportable indicators must be defined in terms of the pre-defined card type’s ***resulting data***

Key takeaway points…

- A **normative behaviour** for CCG processors establishes a **patient-safe** way to concurrently execute multiple CCGs.
- Simplifications on the underlying HL7 specification enable CCGs to be broadly scaled in **regulated markets** where conformance-testing is mandatory.
- The IHE CCG Profile is intended to support the **mainstreaming** of CCGs, and so it is tied to the **patient summary** data specification that will be most readily available within the care delivery network.


Q
&
A