



HL7 FHIR DevDays 2017



Distributing Decision Support with the FHIR Clinical Reasoning Module

Bryn Rhodes, CTO HarmonIQ Health Systems Corporation



Amsterdam, 15-17 November | [@fhir_furore](#) | [#fhirdevdays17](#) | [www.fhirdevdays.com](#)

Opioid Overdose Statistics

- More than 40 people die in the United States every day from overdoses involving prescription opioids
- Since 1999, there have been over 165,000 deaths from overdose related to prescription opioids
- 4.3M Americans engaged in non-medical use of prescription opioids in the last month
- 249M prescriptions for opioid pain medication were written by healthcare providers in 2013
 - Enough prescriptions for every American adult to have a bottle of pills

Opioid Overdose

- Opioid Overdose
- Opioid Basics +
- Data +
- Overdose Prevention +
- Information for Patients +
- Information for Providers -
- Guideline Overview**
- Guideline Resources +
- Training for Providers +

[CDC](#) > [Opioid Overdose](#) > [Information for Providers](#)

CDC Guideline for Prescribing Opioids for Chronic Pain



Improving the way opioids are prescribed through clinical practice guidelines can ensure patients have access to safer, more effective chronic pain treatment while reducing the number of people who misuse, abuse, or overdose from these drugs.

CDC developed and published the [CDC Guideline for Prescribing Opioids for Chronic Pain](#) to provide recommendations for the prescribing of opioid pain medication for patients 18 and older in primary care settings. Recommendations focus on the use of opioids in treating chronic pain (pain

Guideline Recommendations



[Guideline for Prescribing Opioids for Chronic Pain: Recommendations](#) [PDF - 674 KB]

The Running Example

1.2.1 Recommendation #5

When opioids are started, providers should prescribe the lowest effective dosage. **Providers should use caution when prescribing opioids at any dosage, should carefully reassess evidence of individual benefits and risks when considering increasing dosage to ≥ 50 morphine milligram equivalents (MME)/day, and should avoid increasing dosage to ≥ 90 MME/day or carefully justify a decision to titrate dosage to >90 MME/day** (recommendation category: A, evidence type: 3).

- Patient is being prescribed opioids for chronic pain
- Patient does not appear to be at end of life
- If MME ≥ 50 and < 90 , provide a recommendation to taper
- If MME ≥ 90 , provide a recommendation to taper now

Traditional Implementation w/in a Health IT system

- Patient is being prescribed opioids for chronic pain
 - Quite difficult to infer, but could reasonably be something like “an opioid with primary care abuse potential for 80 out of 90 days” or “first prescription for an opioid with primary care abuse potential”
- Patient does not appear to be at end of life
 - Again, quite difficult to infer, but could reasonably be something like “Patient is not in hospice care” or “does not have metastatic or pancreatic cancer”

Morphine milligram equivalents (MME/day)

- If MME ≥ 50 and < 90 , provide a recommendation to taper
- If MME ≥ 90 , provide a recommendation to taper now
- Provider is presented with options:
 - Accepts the recommendation and changes the dosage being prescribed
 - The provider indicates the risks have been carefully assessed and the benefits are outweighed, “snoozes” the recommendation for 3 months
 - The provider is allowed to indicate that the patient is in acute pain, and “snoozes” the recommendation for 1 month
 - The provider is allowed to indicate that the recommendation is invalid or not applicable for this patient, providing a reason

What is the implementation effort involved?

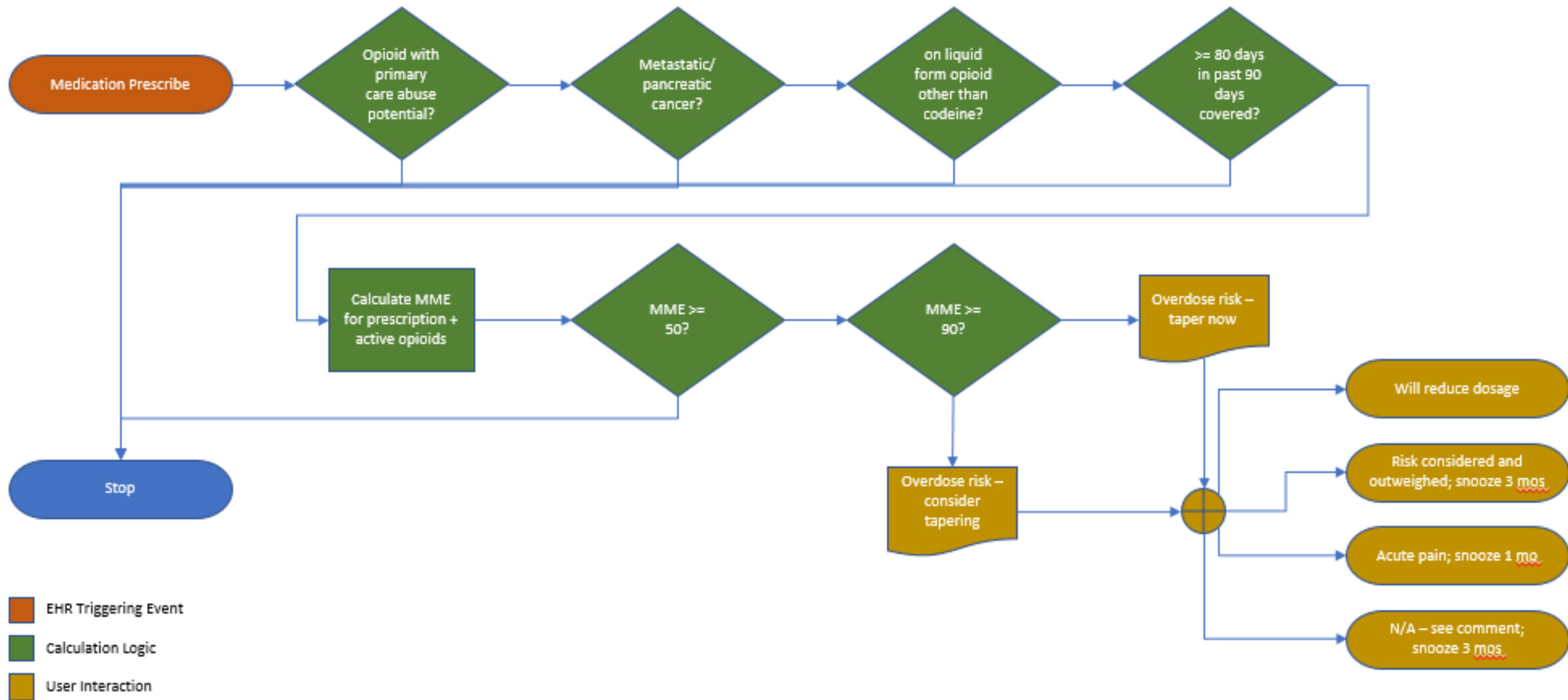
- Turns out to be quite involved, even assuming you can get the medication information in normalized (RxNorm) form
- Obviously subject to data availability with PDMP registries, dispensing information, accurate med rec information, etc.
- A reasonable go-forward is to base the recommendation on the EHRs currently med list for the patient, not perfect, but a starting point
- Calculating MME from prescription information involves calculation dosage frequency and strength, considering things like PRN, ranges, etc.
- In addition, opioids are often combined with other pharmaceuticals, have to calculate based on component ingredients
- Can use RxNav, but calling for each calculation would be prohibitive, needs an offline cache that then needs to be maintained

Can't someone else do it?

- Shouldn't the health IT systems just provide these types of functionality?
- Well yes, and they do, but:
 - Pure volume, there are many more of these types of functionalities than can reasonably be provided by any one system
 - Settings-specific factors, leads to customization and complication
- Okay, but each major system also support customizations
- Well yes, and they do, but:
 - Requires “one-off” implementations at each site
 - Limited ability to share implementation experience and cost

Clinical Reasoning Module

- Allows decision support content to be shared as FHIR resources
- Artifacts that define the *structure* of content including rules, order sets, protocols, and questionnaires
- Libraries that define the *behavior* using logic in Clinical Quality Language



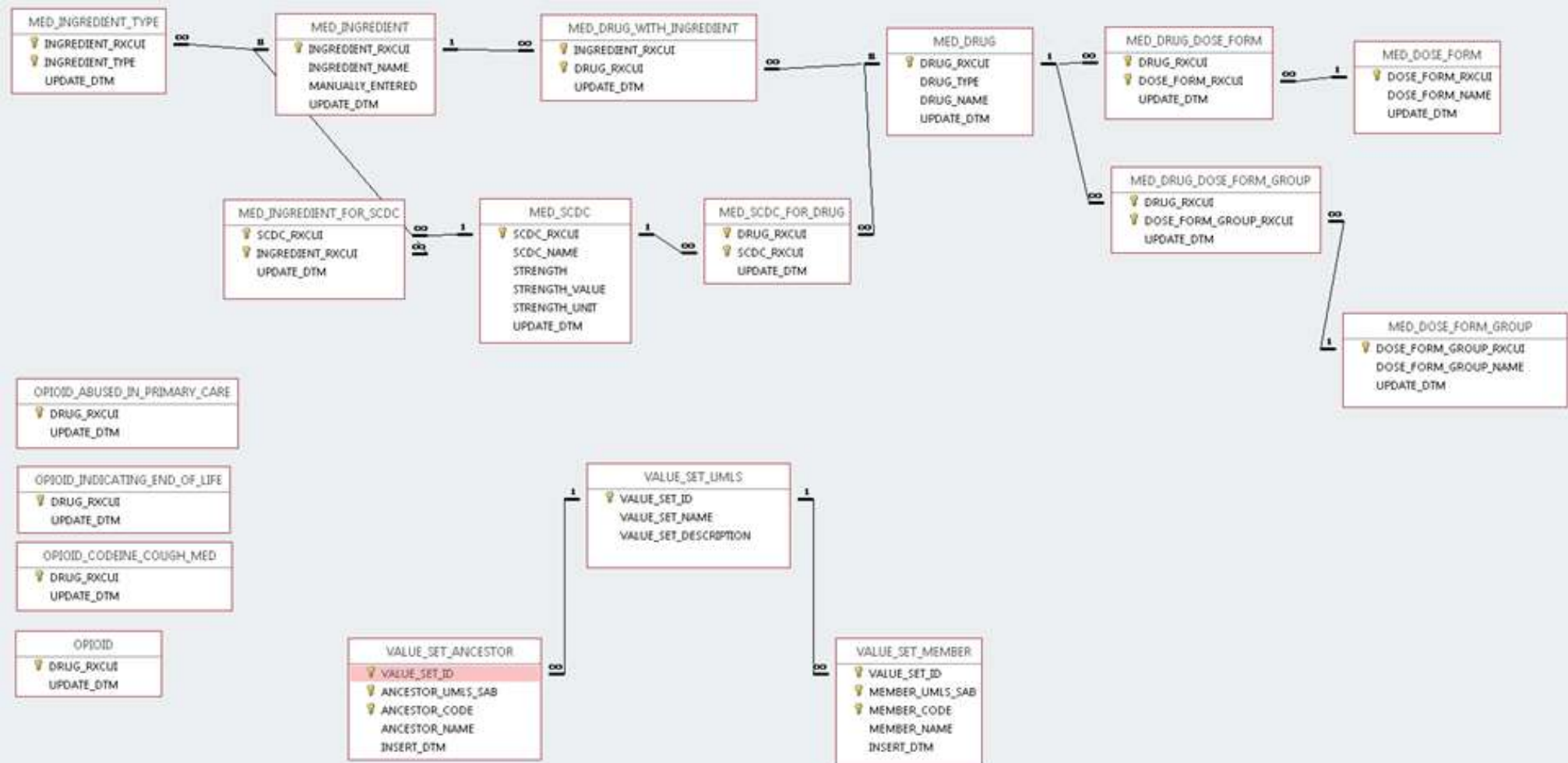
Knowledge-based Implementation

- Patient is being prescribed opioids for chronic pain
 - Define a value set for “Opioids with primary care abuse potential”
 - If the medication being prescribed is in this set, we know we need to take the next step
- Patient does not appear to be at end of life
 - Again, use terminology to define conditions that are known to be terminal

An aside about “process decisions”

- Throughout the implementation process, decisions about how exactly a guideline or recommendation is best realized are being made
- These decisions won't be the same for every setting, and that's okay
- The decisions need to be *documented* and *surfaced*
- Ideally, repositories would support semantic indexing based on these types of decisions

Opioid Management Terminology Knowledge



Portable MME Calculation

```
define function CalculateMMEs(medications List<Tuple { rxNormCode Code, doseQuantity Quantity, dosesPerDay Decimal }>):
  Flatten(
    medications M
    let Ingredients: GetIngredients(M.rxNormCode)
    return
      Ingredients I
      let
        adjustedDoseQuantity: EnsureMicrogramQuantity(M.doseQuantity),
        dailyDose: GetDailyDose(I.ingredientCode, I.strength, I.doseFormCode, adjustedDoseQuantity, M.dosesPerDay),
        factor: GetConversionFactor(I.ingredientCode, dailyDose, I.doseFormCode)
      return {
        rxNormCode: M.rxNormCode,
        doseFormCode: I.doseFormCode,
        doseQuantity: adjustedDoseQuantity,
        dosesPerDay: M.dosesPerDay,
        ingredientCode: I.ingredientCode,
        ingredientName: I.ingredientName,
        strength: I.strength,
        dailyDose: dailyDose,
        dailyDoseDescription: GetDailyDoseDescription(I.ingredientCode, I.ingredientName, I.strength, I.doseFormCode, I.do
        conversionFactor: factor,
        mme: Quantity {
          value: dailyDose.value * factor,
          unit: dailyDose.unit + '/d'
        }
      }
  )
)
```


In STU3

```
define MME:
  Prescriptions P
  let mme: SingletonFrom(OMTKLogic.CalculateMMEs({ { rxNormCode: P.rxNormCode, doseQuantity: P.dose, dosesPerDay: P.dosesPerDay } })
  return {
    rxNormCode: P.rxNormCode,
    isDraft: P.isDraft,
    isPRN: P.isPRN,
    prescription: P.prescription,
    dailyDose: mme.dailyDoseDescription,
    conversionFactor: mme.conversionFactor,
    mme: mme.mme
  }
  sort by if isDraft then 0 else 1, rxNormCode.code
```

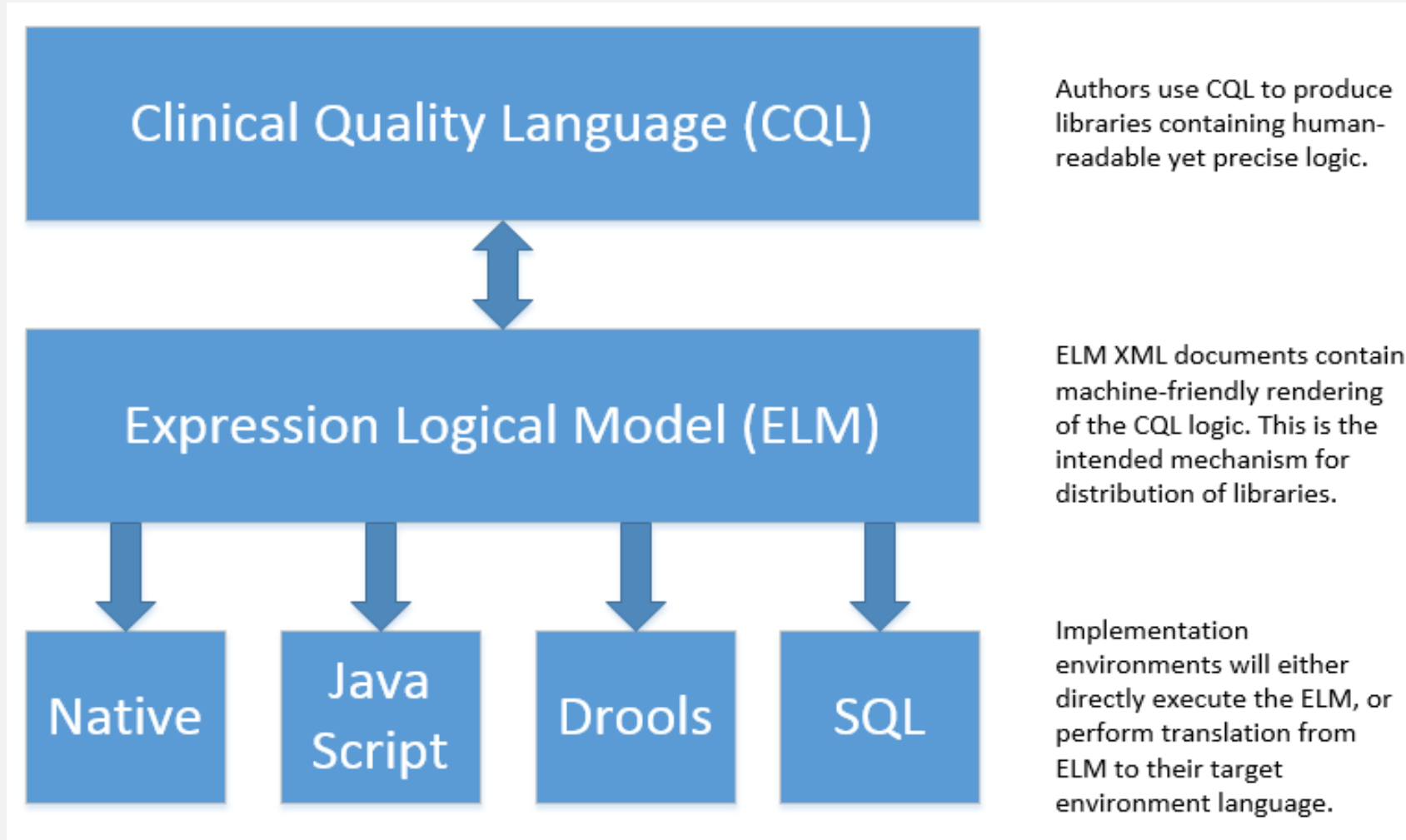
And a PlanDefinition to describe the rule

```
<triggerDefinition>
  <type value="named-event"/>
  <eventName value="medication-prescribe"/>
</triggerDefinition>
<condition>
  <kind value="applicability"/>
  <description value="Is total MME >= 50?"/>
  <language value="text/cql"/>
  <expression value="IsMME50OrMore"/>
</condition>
<groupingBehavior value="visual-group"/>
<selectionBehavior value="exactly-one"/>
<!-- Will reduce dosage -->
<action>
  <description value="Will reduce dosage"/>
  <!-- Open Order Set, where available -->
</action>
<!-- Risk of overdose carefully considered and outweighed by benefit; snooze 3 mo -->
<action>
  <description value="Risk of overdose carefully considered and outweighed by benefit; snooze 3 mo"
</action>
<!-- Acute pain; snooze 1 mo -->
<action>
  <description value="Acute pain; snooze 1 mo"/>
```

Shareable definition, but is it executable?

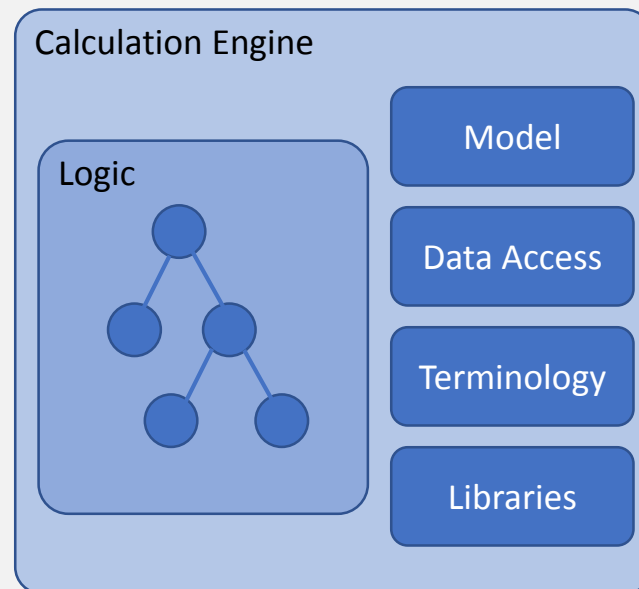
- That's what the CQF Ruler is for
- HAPI FHIR plugin for
 - Evaluating CQL
 - “Realizing” PlanDefinition and ActivityDefinition

CQL Evaluation Architecture



Native CQL (ELM) Engine

Logic is the description of the conditions involved



Model is the structured representation of clinical information

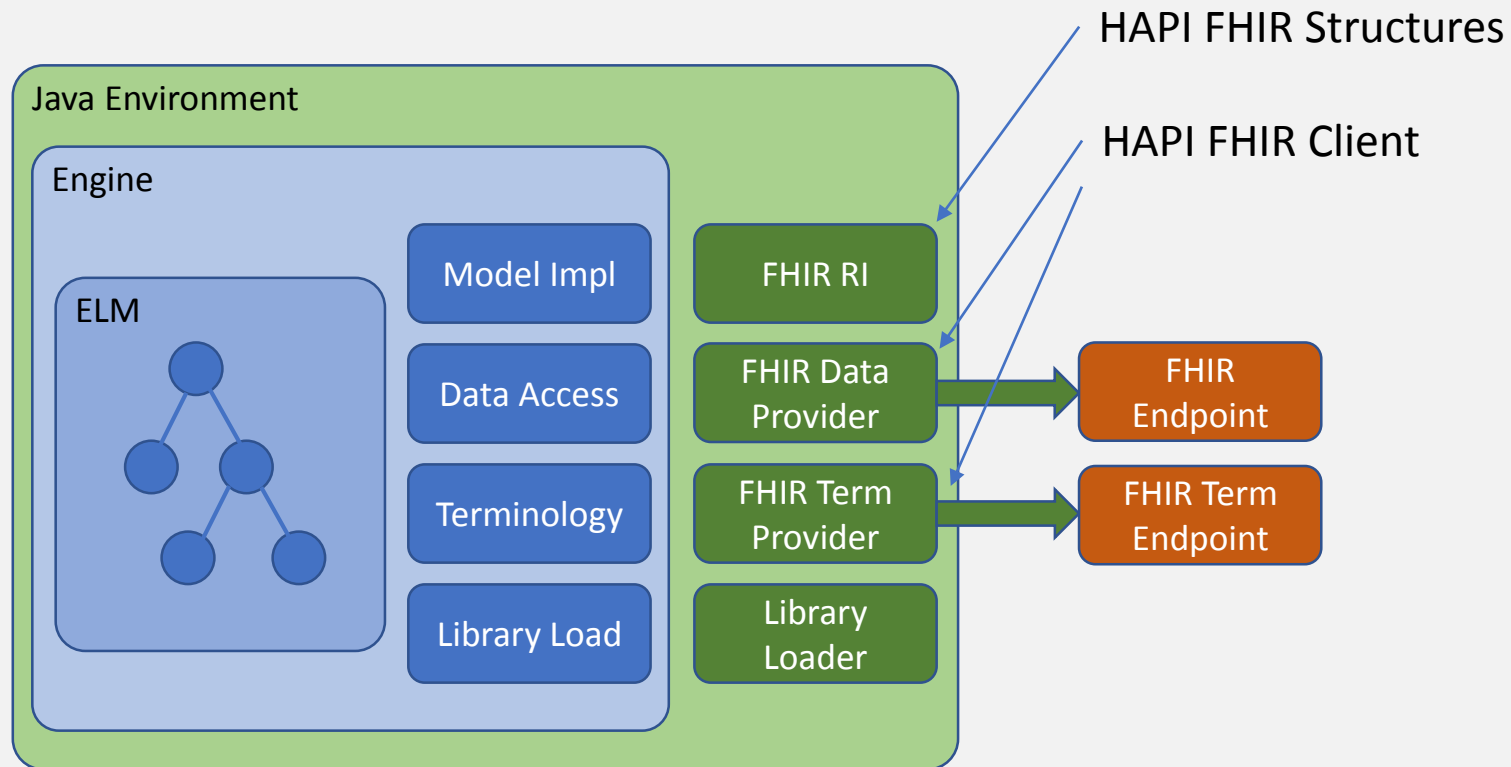
Data Access is how instances of clinical information are retrieved

Terminology is concerned with membership testing and value set expansion

Libraries allow reuse of **Logic**

Engine is the runtime system that performs calculations

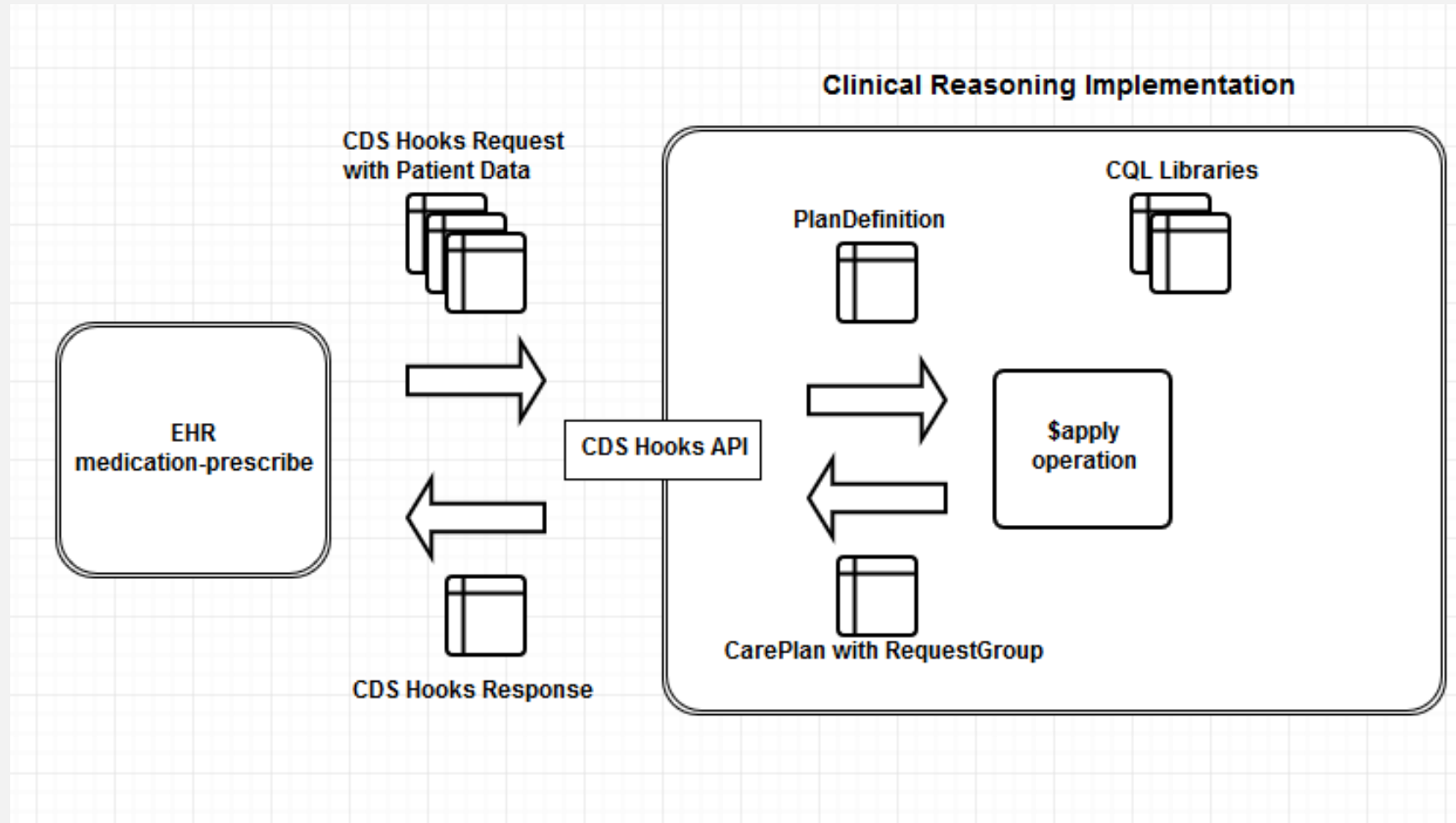
Java-Based CQL Engine



Dynamic Expressions enables....

- PHQ-9 Calculate Total Score
- MedicationRequest to specify dosage in terms of body weight
- RequestGroup to apply different tests based on ANC threshold
- Evaluate quality measures
- And so on....
- But, how do we get it integrated with the EHR?

CDS Hooks Integration



Issues

- Current production systems are DSTU2
 - Runtime transformation, cost for sure, but not prohibitive, at least for this scenario
- Current profiles don't provide enough specificity
 - Defined MedicationRequest to ensure we get
 - Codes as RxNorm
 - Dosage and frequency information

“General” implementation

- PlanDefinitions and the associated libraries written with a general pattern that enables these to be quickly replicated
 - hat tip Grahame for the pattern here
- Currently have definitions for
 - Zika Management
 - CDC Opioid Guidance (#5 and #10)
 - Colorectal, Cervical, and Breast Cancer screening measures
- Rough edges remain, to be sure
 - Welcome to submit a pull request!

Resources

CDC Opioid Prescribing Support Implementation Guide:

- <http://build.fhir.org/ig/cqframework/opioid-cds/>

HEDIS FHIR Implementation Guide:

- <http://build.fhir.org/ig/cqframework/hedis-ig/>

Publicly Available Clinical Reasoning Test Server (CQF Ruler) URL:

- <http://measure.eval.kanvix.com/cqf-ruler/baseDstu3>

Publicly Available CDS Hooks Server URL:

- <http://measure.eval.kanvix.com/cqf-ruler/cds-services>

Walkthroughs

Activity Definition \$apply

- [https://github.com/DBCG/cqf-ruler/wiki/ActivityDefinition-\\$apply-Operation](https://github.com/DBCG/cqf-ruler/wiki/ActivityDefinition-$apply-Operation)

Plan Definition \$apply

- [https://github.com/DBCG/cqf-ruler/wiki/PlanDefinition-\\$apply-Operation](https://github.com/DBCG/cqf-ruler/wiki/PlanDefinition-$apply-Operation)

CDS Hooks Request:

- <https://github.com/DBCG/cqf-ruler/wiki/CDS-Hooks-Request-Processing>

Quality Measure Evaluation:

- <https://github.com/DBCG/cqf-ruler/wiki/Quality-Measure-Processing>

Questions?