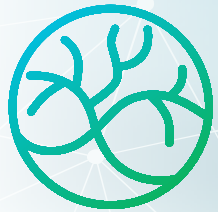


CORILUS
Connecting Care

The TTC 2023 KMEHR to FHIR Case

With ATL/EMFTVM reference solution

Outline

- Context: KMEHR & FHIR
- Case structure
- Task description
- Benchmark framework & evaluation

Context

KMEHR

Context: KMEHR

- Kindly Marked-up Electonic Healthcare Record
  - Belgian medical data standard introduced in 2002
  - Exchange of structured clinical information
  - Lead to the specification of about 20 specific XML messages
- Summarized Electronic Health Record (SumEHR)
  - KMEHR message used for the exchange of medical information
  - Summarizes minimal data a physician needs to understand medical status of the patient and to ensure the continuity of care
  - Introduced in 2005
  - Belgian medical software should be capable of exporting a SumEHR message for any given patient

Context: SumEHR header

```
<kmehrmessage>
    <header>
        <standard>
            <cd S="CD-STANDARD" SV="1.0">20161201</cd>
        </standard>
        <id S="ID-KMEHR" SV="1.0">14296612004.2016052000575959 8</id>
        <date>2016-05-20</date><time>00:57:59</time>
        <sender>
            <hcparty>
                <id S="ID-HCPARTY" SV="1.0">14296612004</id>
                <cd S="CD-HCPARTY" SV="1.10">persphysician</cd>
                <firstname>Leonard</firstname>
                <familyname>McCoy</familyname>
            </hcparty>
        </sender>
        <recipient>...</recipient>
    </header>
    ...
```

"CD" coding element
coding system & version

"ID" identifier element
NIHII number of physician

Context: SumEHR body

```
...
    <folder><id S="ID-KMEHR" SV="1.0">1</id>
        <patient>
            <id S="INSS" SV="1.0">49112002395</id>
            <firstname>JAN</firstname>
            <familyname>JANSSENS</familyname>      ...
        </patient>
        <transaction>
            <id S="ID-KMEHR" SV="1.0">1</id>
            <cd S="CD-TRANSACTION" SV="1.9">sumehr</cd>
            <date>2016-05-20</date><time>00:57:59</time>
            <author>...</author>
            <item>
                <id S="ID-KMEHR" SV="1.0">2</id>
                <cd S="CD-ITEM" SV="1.11">contactperson</cd>
                <cd S="CD-CONTACT-PERSON" SV="1.0">father</cd>
                <content><person>...</person></content>
            </item>  …
        </transaction>
    </folder>
</kmehrmessage>
```

"ID" identifier element
INSS social security nr

KMEHR transaction type
SumEHR

Medical content
e.g. contactperson, problem, medication, vaccine, allergy, ...

Context

FHIR

Context: FHIR

- Fast Healthcare Interoperability Resources
  - International standard by Health Level 7 (HL7) introduced in 2011
  - Builds on previous data format standards, e.g. HL7 v.2.x and HL7 v.3.x.
  - Supports profiles (https://www.hl7.org/fhir/profiling.html)
- International Patient Summary (IPS)
  - FHIR profile
  - Electronic health record extract containing essential healthcare information about a subject of care
  - FHIR equivalent of SumEHR

Context: FHIR IPS header

```
<Bundle xmlns="http://hl7.org/fhir">
  <type value="document"/>
  <entry>
    <fullUrl value="urn:uuid:070e65cc-68ed-4373-a323-eb245dac94dd"/>
    <resource>
      <Composition>
        <id value="070e65cc-68ed-4373-a323-eb245dac94dd"/>
        <identifier>
          <system value="urn:oid:2.16.724.4.8.10.200.10"/>
          <value value="070e65cc-68ed-4373-a323-eb245dac94dd"/>
        </identifier>
        <type>
          <coding>
            <system value="http://loinc.org"/>
            <code value="60591-5"/>
            <display value="Patient summary Document"/>
          </coding>
        </type>
        ...
```

Document identifier

Header is contained in a “Composition” element, which also contains a significant part of the medical data payload (body)

Oid code for FHIR IPS

LOINC code for FHIR IPS

Context: FHIR IPS body (1)

```
...
  <subject>
    <reference value="Patient/b675e3d9-5471-4037-8b56-0df5c8060f32"/>
  </subject>
  <author><reference value="Practitioner/e7c5ec10-d4a1-4fa8-a44f-80dec4d722ea"/></author>
  <custodian><reference value="Practitioner/7122e278-6205-4ad5-b185-5da2a20f29bc"/></custodian>
  <section>
    <title value="Medication"/>
    <code>
      <coding>
        <system value="http://loinc.org"/>
        <code value="10160-0"/>
        <display value="History of Medication use Narrative"/>
      </coding>
    </code>
    <entry>
      <reference value="Medication/ec60b2e6-dc2f-4ced-ba3a-ea64715aeb2d"/>
    </entry>    ...
  </section>    ...
 </Composition>
</resource>
</entry>
...
```

Administrative elements are referenced from inside the Composition

Composition element serves as a table of contents

Medical elements are referenced from inside the Composition

Context: FHIR IPS body (2)

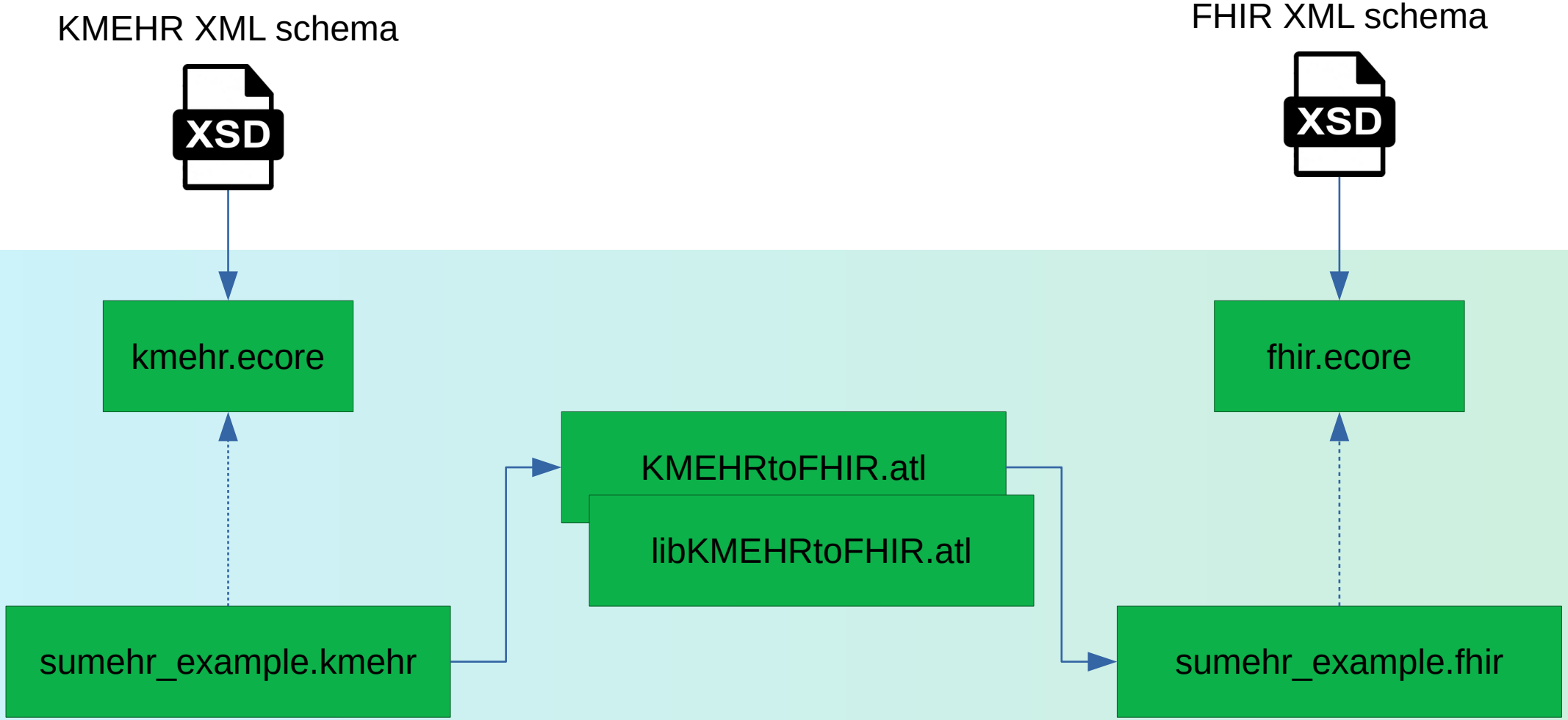
```
...
<entry>
  <fullUrl value="urn:uuid:ec60b2e6-dc2f-4ced-ba3a-ea64715aeb2d"/>
  <resource>
    <Medication>
      <id value="ec60b2e6-dc2f-4ced-ba3a-ea64715aeb2d"/>
      <code>
        <coding>
          <system value="https://www.ehealth.fgov.be/standards/fhir/medication/NamingSystem/cnk-codes"/>
          <code value="0895540"/>
          <display value="MEDROL COMP 20X32MG"/>
        </coding>
      </code>
      <status value="active"/>
    </Medication>
  </resource>
 </entry>      ...
</Bundle>
```

Medical elements details are enumerated after the Composition element

This TTC case copies the medication coding system from KMEHR for simplicity, but FHIR IPS should include an international coding system to be of use abroad
e.g. ATC: http://www.whocc.no/atc

Case structure

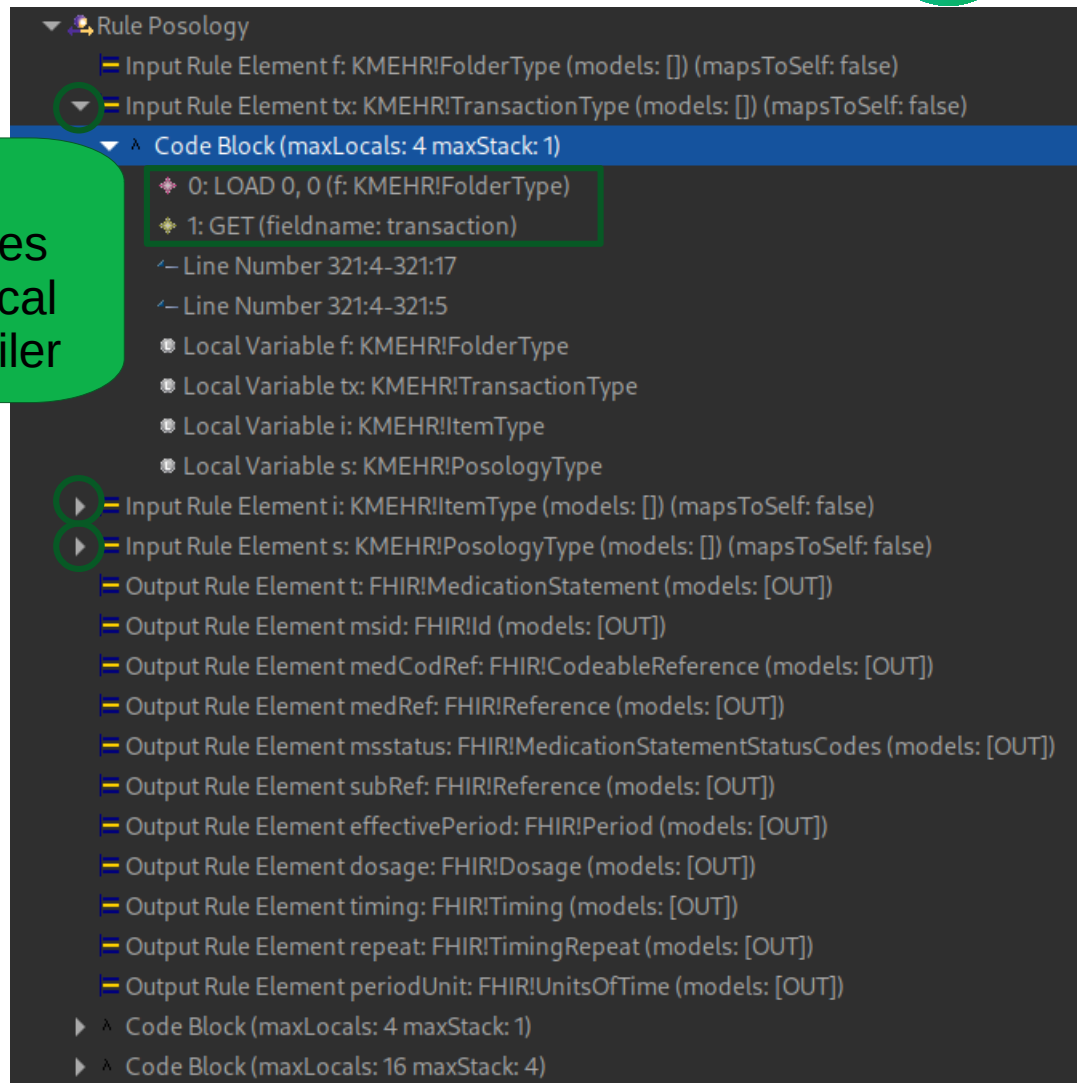
Case structure



Case structure

```
rule Posology {
    from
        f : KMEHR!FolderType,
        tx : KMEHR!TransactionType,
        i : KMEHR!ItemType,
        s : KMEHR!PosologyType (
            i.posology = s and
            tx.item->includes(i) and
            f.transaction->includes(tx) and
            i.isMedication
        )
    to
        t : FHIR!MedicationStatement mapsTo s (
            id <- msid,
            medication <- medCodRef,
            status <- msstatus,
            subject <- subRef,
            effectivePeriod <- effectivePeriod,
            dosage <- Sequence{dosage}
        ),    ...
```

Reference ATL solution showcases EMFTVM 4.8.0 local search plan compiler



Task description

Task description

- Mandatory task:
  - Re-implement/improve original transformation
  - In a way that lends itself better to after-the-fact consistency checking
- Optional task
  - Define the reverse transformation that translates the generated FHIR IPS document back to SumEHR.

Benchmark framework & evaluation

Benchmark framework

- Based on TTC 2017 Smart Grid case
- Three phases
  - Initialization, Load, Run
- Solution requirements
  - Output in CSV
    - Tool, Source, Target, RunIndex, PhaseName, MetricName
  - Solution.ini file tells framework how to run solution
- Running the benchmark
  - Requires Python >= 3.3

Evaluation

- Criteria
  - How efficient is the approach in time and space (memory)?
  - How understandable is the transformation code for domain experts to review and validate?
  - *From the task description:* How well does the approach lend itself better to after-the-fact consistency checking?
  - Was the optional task implemented, and did the chosen tool provide support to make this easier?

Thank you

For submitting your solution to this case!