

Using the implies method again with two longer worked examples

Overview

We will move on to write two new GELLO modules. In the first we will do a simple result that returns a text message for flagging an asthmatic patient receiving too many "reliever" metered aerosol puffers in a space of time and suggesting additional 'preventer' therapy. The second will make use of the Past history class in the VMR in the diagnosis of a unilateral red eye.

Asthma example

The time has come to use a larger data file. Save the following as *thirdTest.xml* . Note we are adding flesh to the bones of this patient's EHR/VMR and now we have two illnesses and some medications. [The VMR allows both a problem list and a past history list. We will stick with Past History for now but we could equally be populating the problem list if we preferred.]

```
<?xml version="1.0" encoding="UTF-8"?>

<singlePatient xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
               xsi:noNamespaceSchemaLocation="/iso-21090-datatypes.xsd">

  <patient>

    <patientID
      root="1.2.36.174030967"
      extension="1234567892"
      reliability="VRF"
      scope="OBJ"/>

    <patientName>
      <part type="GIV" value="Alice" />
      <part type="GIV" value="A." />
      <part type="FAM" value="Someone" />
    </patientName>

    <dob value="19550621"/>

    <gender code="248152002"
      codeSystem="2.16.840.1.113883.6.96"
      codeSystemName="SNOMED-CT">
      <displayName value = "Female" />
    </gender>

    <ssn value="987-65-4320"/>

    <address use="WP">
      <part type="AL" value="1050 W Wishard Blvd" />
      <part type="CTY" value="Indianapolis" />
      <part type="STA" value="IN" />
      <part type="ZIP" value="46240" />
    </address>

  </patient>
```

```

    <allergies>
      <allergenType code="373873005"
        codeSystem="2.16.840.1.113883.6.96"
        codeSystemName="SNOMED-CT">
        <displayName value = "pharmaceutical / biologic
product" />
      </allergenType>
      <allergenCode code="111088007"
        codeSystem="2.16.840.1.113883.6.96"
        codeSystemName="SNOMED-CT">
        <displayName value = "latex (product)" />
      </allergenCode>
      <allergySeverity code="24484000"
        codeSystem="2.16.840.1.113883.6.96"
        codeSystemName="SNOMED-CT">
        <displayName value = "severe" />
      </allergySeverity>
      <allergyReaction code="39579001"
        codeSystem="2.16.840.1.113883.6.96"
        codeSystemName="SNOMED-CT">
        <displayName value = "anaphylaxis" />
      </allergyReaction>
      <identificationDate value="1980"/>
    </allergies>
  </allergies>
  <allergies>
    <allergenType code="373873005"
      codeSystem="2.16.840.1.113883.6.96"
      codeSystemName="SNOMED-CT">
      <displayName value = "pharmaceutical / biologic
product" />
    </allergenType>
    <allergenCode code="27658006"
      codeSystem="2.16.840.1.113883.6.96"
      codeSystemName="SNOMED-CT">
      <displayName value = "Amoxicillin" />
    </allergenCode>
    <allergySeverity code="24484000"
      codeSystem="2.16.840.1.113883.6.96"
      codeSystemName="SNOMED-CT">
      <displayName value = "severe" />
    </allergySeverity>

```

```

        <allergyReaction code="39579001"
            codeSystem="2.16.840.1.113883.6.96"
            codeSystemName="SNOMED-CT">
                <displayName value = "anaphylaxis" />
            </allergyReaction>

        <identificationDate value="1980"/>
    </allergies>

    <historyOfPastIllness>
        <pastIllness code="302914006"
            codeSystem="2.16.840.1.113883.6.96"
            codeSystemName="SNOMED-CT">
                <displayName value = "Barrett's esophagus" />
            </pastIllness>

        <temporalContext code="410587003"
            codeSystem="2.16.840.1.113883.6.96"
            codeSystemName="SNOMED-CT">
                <displayName value = "Past - specified" />
            </temporalContext>

        <illnessDates>
            <!--IVL_TS -->
            <low value="2000" />
        </illnessDates>

        <notesOnIllness></notesOnIllness>
    </historyOfPastIllness>

    <historyOfPastIllness>
        <pastIllness code="195967001"
            codeSystem="2.16.840.1.113883.6.96"
            codeSystemName="SNOMED-CT">
                <displayName value = "Asthma" />
            </pastIllness>

        <temporalContext code="410587003"
            codeSystem="2.16.840.1.113883.6.96"
            codeSystemName="SNOMED-CT">
                <displayName value = "Past - specified" />
            </temporalContext>

        <illnessDates>
            <!--IVL_TS -->
            <low value="2005" />
        </illnessDates>

        <notesOnIllness></notesOnIllness>
    </historyOfPastIllness>

```

```

</historyOfPastIllness>

<medications>

  <currentMedications>

    <!--1-->

      <medicationCode code="317334001"

        codeSystem="2.16.840.1.113883.6.96"

        codeSystemName="SNOMED-CT">

          <displayName value = "Esomeprazole 40mg
tablet" />

          <translation code="606731"

            codeSystem="
2.16.840.1.113883.6.88"

            codeSystemName="RxNorm">

              <displayName value =
"Esomeprazole 40 MG Delayed Release Oral Capsule [Nexium]" />

            </translation>

          </medicationCode>

          <dosingSig code="229797004"

            codeSystem="2.16.840.1.113883.6.96"

            codeSystemName="SNOMED-CT">

              <displayName value = "Once daily" />

            </dosingSig>

            <requestedGiveRate></requestedGiveRate><!--
PQ eg 100mls an hour-->

            <medicationStartDate value="20160128" />

            <medicationStopdate> </medicationStopdate>

            <totalDailyDose> </totalDailyDose>

            <reasonForCessation> </reasonForCessation>

            <indication code="302914006"

              codeSystem="2.16.840.1.113883.6.96"

              codeSystemName="SNOMED-CT">

                <displayName value = "Barrett's esophagus"
/>

              </indication>

            <replacedBy> </replacedBy>

          </currentMedications>

          <!--2-->

          <currentMedications>

            <medicationCode code="376928006"

              codeSystem="2.16.840.1.113883.6.96"

              codeSystemName="SNOMED-CT">

                <displayName value = "Albuterol 90mcg/inh
aerosol" />

```

```

                <translation code="801905"
                codeSystem="
2.16.840.1.113883.6.88"
                codeSystemName="RxNorm">
                <displayName value = "60
ACTUAT Albuterol 0.09 MG/ACTUAT Metered Dose Inhaler [Ventolin]" />
                </translation>
            </medicationCode>
            <dosingSig code="25761000"
                codeSystem="2.16.840.1.113883.6.96"
                codeSystemName="SNOMED-CT">
                <displayName value = "As required" />
            </dosingSig>
            <medicationStartDate value="20160426" />
        </currentMedications>
        <!--3-->
        <currentMedications>
            <medicationCode code="376928006"
                codeSystem="2.16.840.1.113883.6.96"
                codeSystemName="SNOMED-CT">
                <displayName value = "Albuterol 90mcg/inh
aerosol" />
                <translation code="801905"
                codeSystem="
2.16.840.1.113883.6.88"
                codeSystemName="RxNorm">
                <displayName value = "60
ACTUAT Albuterol 0.09 MG/ACTUAT Metered Dose Inhaler [Ventolin]" />
                </translation>
            </medicationCode>
            <dosingSig code="25761000"
                codeSystem="2.16.840.1.113883.6.96"
                codeSystemName="SNOMED-CT">
                <displayName value = "As required" />
            </dosingSig>
            <medicationStartDate value="20160502" />
        </currentMedications>
        <!--4-->
        <currentMedications>
            <medicationCode code="376928006"
                codeSystem="2.16.840.1.113883.6.96"
                codeSystemName="SNOMED-CT">

```

```

aerosol" />
                                <displayName value = "Albuterol 90mcg/inh
                                <translation code="801905"
                                codeSystem="
2.16.840.1.113883.6.88"
                                codeSystemName="RxNorm">
                                <displayName value = "60
ACTUAT Albuterol 0.09 MG/ACTUAT Metered Dose Inhaler [Ventolin]" />
                                </translation>
                                </medicationCode>
                                <dosingSig code="25761000"
                                codeSystem="2.16.840.1.113883.6.96"
                                codeSystemName="SNOMED-CT">
                                <displayName value = "As required" />
                                </dosingSig>
                                <medicationStartDate value="20160516" />
                                </currentMedications>
                                </medications>
                                </singlePatient>

```

Load this data into the editor as outlined in previous tutorials. Notice the new data we have added.

Start as usual:

```
Context HL7_v2_VMR_V1::SinglePatient
```

Does the patient have asthma?:

```

Let Asthma:CD = factory.CD_SNOMED('195967001', 'Asthma')
Let hasAsthma: Boolean = historyOfPastIllness -> exists(pastIllness.
implies(Asthma).value)

```

[Note these two lines are subtly different to previous examples but work just as well - there is more than one way to do things - can you spot the differences?]

Look for albuterol ('reliever' puffer) scripts:

```

Let albuterol90_SCT:CD = factory.CD_SNOMED_CT('376928006')
Let allAlbuterolScripts = medications.currentMedications->select
(medicationCode.implies(albuterol90_SCT).value)

```

Get the medication start dates for these scripts:

```

Let allAlbuterolMAScriptdates: Sequence(TS) = allAlbuterolScripts
->select(medicationCode.implies(albuterol90_SCT).value).
medicationStartDate

```

Get last two dates:

```

Let mostRecentAlbuterolDate: TS = allAlbuterolMAScriptdates->last()
Let penultimateAlbuterolDate: TS = If mostRecentAlbuterolDate.
oclIsDefined() then
    allAlbuterolMAScriptdates.excluding
(mostRecentAlbuterolDate)->last()
    else null
endif

```

Get the time between them:

```
Let timeGapInDays: PQ = timeGap.convert('d')
```

If `timeGapInDays.oclIsDefined()` then

```

        else ''
    endif
    else ''
endif

```



Add the following in between **</patient>** and **<allergies>**, should be about line 28 (line 56 if your file has become double spaced), save:

And add this section to a space made just above **<medications>** and save:

```
</historyOfPastIllness>
<historyOfPastIllness>
<pastIllness code="64766004"
codeSystem="2.16.840.1.113883.6.96"
codeSystemName="SNOMED-CT">
```

```

        <displayName value = "ulcerative colitis" />
    </pastIllness>
    <temporalContext code="410587003"
        codeSystem="2.16.840.1.113883.6.96"
        codeSystemName="SNOMED-CT">
        <displayName value = "Past - specified" />
    </temporalContext>
    <illnessDates>
        <!--JVL_TS -->
        <low value="2008" />
    </illnessDates>
    <notesOnIllness></notesOnIllness>
</historyOfPastIllness>

```

Iritis is sometimes associated with other diseases including but not limited to lupus, psoriatic arthritis, ankylosing spondylitis, sarcoidosis, inflammatory bowel disease, rheumatoid arthritis, toxoplasmosis, histoplasmosis, tuberculosis, syphilis and the presence of the HLAB27 antigen. So let's write some code that looks for these and in the presence of a red eye flags a warning. The result of this GELLO code will be a Tuple that includes a weighting on the importance of the warning message.

Here's the code:

```

Context HL7_v2_VMR_V1::SinglePatient

Let hasPastIllnessOfAssociatedIllnessOfIritis: Boolean =

    historyOfPastIllness->exists(pastIllness.implies(factory.
CD_SNOMED('200936003', 'lupus')).value or

        pastIllness.implies(factory.CD_SNOMED
('156370009', 'psoriatic arthritis')).value or

        pastIllness.implies(factory.CD_SNOMED
('9014002', 'psoriasis')).value or

        pastIllness.implies(factory.CD_SNOMED
('9631008', 'ankylosing spondylitis')).value or

        pastIllness.implies(factory.CD_SNOMED
('31541009', 'sarcoidosis')).value or

        pastIllness.implies(factory.CD_SNOMED
('64766004', 'ulcerative colitis')).value or

        pastIllness.implies(factory.CD_SNOMED
('34000006', 'crohns disease')).value or

        pastIllness.implies(factory.CD_SNOMED
('69896004', 'rheumatoid arthritis')).value or

        pastIllness.implies(factory.CD_SNOMED
('712680005', 'Human leukocyte antigen B27 test positive')).value or

        pastIllness.implies(factory.CD_SNOMED
('187192000', 'toxoplasmosis')).value or

        pastIllness.implies(factory.CD_SNOMED
('12962009', 'histoplasmosis')).value or

        pastIllness.implies(factory.CD_SNOMED
('56717001', 'tuberculosis')).value or

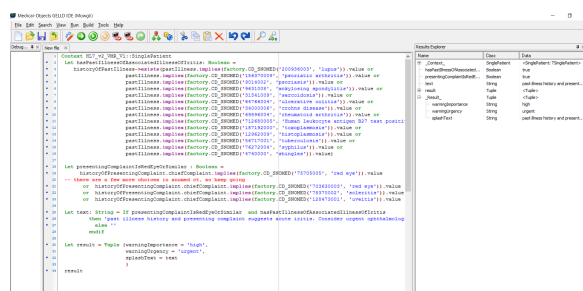
        pastIllness.implies(factory.CD_SNOMED
('76272004', 'syphilis')).value or

        pastIllness.implies(factory.CD_SNOMED
('4740000', 'shingles')).value)

```

```
Let result = Tuple {warningImportance = 'high',
                    warningUrgency = 'urgent',
                    splashText = text
                    }

result
```



But the point of this second example is to illustrate the potential power of a suite of hundreds of installed GELLO expressions, quietly running in the background and then triggering a warning or a message when conditions are ripe.

That's the end of this tutorial.