

Migration from HL7 CDA to FHIR in Infectious Disease System of Estonia

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Abstract. On the basis of the Estonian National Health System, we propose a universal and reusable methodology for migrating HL7 CDA documents or their components.

Keywords. HL7 FHIR, HL7 CDA, Interoperability, Estonian NHS

Introduction, Objectives and Methodology

Many countries have successfully implemented HL7 V3 and CDA standards to ensure document-based interoperability between EHRs, registries and healthcare institutions [4, 5, 7]. HL7 CDA is a document markup standard that specifies the structure and semantics of clinical documents [2]. The biggest drawback of the HL7 CDA document-based approach is the timing of sharing the information. The document is generally shared once all the agreed data elements have been precisely filled in and the necessary confirmations received.

The Estonian Health Information System (TIS²) is a set of healthcare services that covers many aspects of health care – discharge summaries, referrals, e-prescriptions, the national appointment system, etc. [5]. TIS development began in 2005 and is based on HL7 V3 and CDA standards. Today, Estonian TIS is transitioning from a document-based approach to an event-based approach by utilizing the HL7 FHIR standard. During this transition, one of the tasks is to describe the patient's socioeconomic status according to the FHIR profile.

One of the data exchange services offered by TIS is NAKIS [8], which serves the purpose of sharing information about dangerous diseases, infections and suspected infections through the Infectious Diseases Information System to the register of infectious diseases, including AIDS, hepatitis and COVID-19. Regarding the COVID-19 pandemic, the NAKIS notice was one of the most frequently used notices from 2020 to 2021. In order to thoroughly analyse the reasons for infection, NAKIS requires the collection of social characteristics: occupation, employment organisation, and educational or preschool institution.

Socioeconomic status (SES) is defined as a measure of a person's combined economic and social status and tends to be positively associated with better health [1]. This entry focuses on three common measures of socioeconomic status: education,

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² Letter 'T' comes from the Estonian word 'Tervis', meaning Health.

income, and occupation. Listing 1 contains a fragment of the NAKIS report message with socioeconomic elements. In the NAKIS report, a message from the employee organisation or educational or preschool institution is presented as free text. Occupation is defined as *ValueSet* 1.3.6.1.4.1.28284.6.2.3.1 [9]. Officially, the register of occupations is managed by the Department of Statistics. The attribute socioeconomic status is defined as *ValueSet* 1.3.6.1.4.1.28284.6.2.3.9 [10] with specified values. In NAKIS, however, the message uses the occupation name as free text instead of a code.

Listing 1. Fragment of NAKIS message with extended patient section

```
<patient classCode="PSN" determinerCode="INSTANCE">
  <name>
    <given>First name</given>
    <family>Last name</family>
  </name>
  ...
  <!-- Estonian extension of COCT_MT030200UV04.Person -->
  <ext:patientPerson ext:HL7-ClassName="PSN" ext:HL7-
    Domain="PRPA_RM000000" ext:realmCode="EE">
    <ext:asEmployment>
      <ext:jobCode codeSystem
        ="1.3.6.1.4.1.28284.6.2.3.1.1"
        codeSystemName="Occupation" displayName="
        Developer"/>
      <ext:employerOrganization>
        <ext:id nullFlavor="NI"/>
        <ext:name>Kodality</ns2:name>
      </ext:employerOrganization>
    </ext:asEmployment>
    <!-- Socioeconomic status -->
    <ext:asMember classCode="MBR">
      <ext:groupEntity classCode="ORG"
        determinerCode="INSTANCE">
        <ext:id extension="1" root
          ="1.3.6.1.4.1.28284.6.2.3.9.2"
          assigningAuthorityName="employed"/>
      </ext:groupEntity>
    </ext:asMember>
  </ext:patientPerson>
</patient>
```

According to the plan, NAKIS was migrated from HL7 V3 and CDA to FHIR. During the migration, the following questions had to be answered:

- What resources are suitable for submitting SES?
- What similar FHIR profiles and terminologies exist in the world?

The aim was to create FHIR profiles and terminology that are suitable for the transmission of SES in Estonia and potentially comprehensible in other countries [3].

1. Results and Conclusion

As a result of our project, collecting information in the form of granular observations, the owner of the NAKIS register always receives up-to-date and correct information that can be analysed from the necessary angle. The owner of the NAKIS register can now produce the necessary statistical values by creating a decision table, as provided in Table 1, or using a rule engine for the calculation of values. We have created profiles for

EducationLevel and *EducationRecord* and provided suggestions for reusing OHD profiles. The decision table shows other observations, such as parental leave and imprisonment period, which we have not touched on in this article but which are important for calculating socioeconomic status and can be reported analogously to the described indicators. The given information often remains unreported upon patient registration at the registry office.

Table 1. Decision table for socioeconomic status calculation for NAKIS

| Code | Name | Education Level | Education Record | ODH Employment Status | Parental Leave | Retired | Combat Period | Imprisonment Period | Disability |
|------|--|-----------------------|------------------|-----------------------|----------------|------------|---------------|---------------------|------------|
| 1 | working employee, contractor, freelancer | | | employed | | | | | |
| 2 | unemployed or actively looking for work | | | unemployed | | | | | |
| 3 | conscript | | | | | | active | | |
| 4 | detainee | | | | | | | active | |
| 5 | student | | active | | | | | | |
| 6 | incapacity pensioner | | | | | | | | active |
| 7 | old-age pensioner | | | denial of "employed" | | active | | | |
| 8 | other pensioner | | | | | active | | | active |
| 9 | parental leave | | | | active | | | | |
| 10 | housewife or not looking for work | | | not in labor force | | | | | |
| 13 | preschool child attending kindergarten | no schooling | active | | | | | | |
| 14 | preschool home | no schooling | | | | | | | |
| 99 | unknown | unknown or not exists | not active | does not exist | not active | not active | not active | not active | not active |

In an ideal world, information on employment and occupation is delivered automatically to the Estonian Health Services from the Estonian Employment Register, information on education from the Ministry of Education and Research, information on combat periods from the Ministry of Defence, imprisonment information from the Ministry of the Interior and parental leave information from the Ministry of Social Affairs, whereas healthcare facilities should be free from the obligation to send this kind of data. As a result of our work, a reusable migration methodology for CDA documents or their components was developed. The methodology comprises the following steps:

- Analyse each element and each list critically and decompose them, where necessary
- Create a list of all possible search keywords and their synonyms
- Check the FHIR site for profiles matching your search keywords
- Check the FHIR register for profiles matching your search keywords
- Reuse profiles, where possible
- Search openEHR for suitable archetypes; validate their suitability and reuse, if possible
- Search SNOMED and LOINC for matching terminology based on all search keywords
- Develop/adapt/adopt appropriate profiles and terminology

It is a common opinion that characteristics reflecting the patient's status, such as SES, must be part of the Patient resource. According to the modelling principle, it is reasonable to add an attribute to a resource if it reflects an event [6] that is complete, i.e. it changes very rarely, e.g. one or two times during the life of the resource. Since SES may change frequently e.g. several times a year, and multiple indicators may be valid simultaneously, and since a historical overview of changes in SES may generally be clinically useful, socioeconomic status cannot be an attribute or an extension of the Patient resource but a separate FHIR Observation resource with its own profile or profiles.

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