Appendix A

The openEHR Guideline Definition Language (GDL) is a formal language designed to represent clinical knowledge associated with clinical decision making. It can be considered to be a semantically well-defined clinical information model that allows the expression and sharing CIGs across organizations and platforms.¹ By leveraging the openEHR models (reference model and archetype model), the GDL is able to represent both clinical knowledge and rules within the guidelines.² The reference model (RM) and archetype model (AM) are the core design specifications of the openEHR approach and these allow the separation of knowledge-modeling from system-development tasks. The RM is a generic and underlying model that defines the semantics and structure of the information. The AM represents a distinct domain-level concept that specifies constraints on the data structures that have been defined by the RM.³ Using the openEHR approach, the GDL should be agnostic to natural languages and reference terminologies.

Example 1 shows a simple GDL that helps us to calculate BMI scores. The main structure of the GDL is that it is composed of four sections; they are the header, the description, the definition and the ontology. The header section (example 1, block A) contains the meta-information of the CDS rules, including the current version, the unique identifier and language information.
Example 1: A general structure of Guideline Definition Language

The *description* section (example 1, block B) records lifecycle state, keywords and information about the purpose, use and misuse of the guidelines (see example 2 for more details).

| (GUIDE) | <
| gdl_version = "0.1" |
| id = "BMI.Calculation.v.1-Revised function" |
| concept = "gt0000" |
| language = (LANGUAGE) <original_language = <[ISO_639-1::en]>> |
| description = (RESOURCE_DESCRIPTION) < |
| (Please refer example 2) |
| definition = (GUIDE_DEFINITION) < |
| (Please refer example 3) |
| ontology = (GUIDE_ONTOLOGY) < |
| (Please refer example 4) |
| > |

Example 2: The description block of Guideline Definition Language

The *definition* section consists of two parts, one is the *archetype binding* part and the

| description= (RESOURCE_DESCRIPTION) |
| details= < |
| ["en"] = (RESOURCE_DESCRIPTION_ITEM) |
| copyright="
| keywords="obesity", "index", "body mass", "BMI"
| purpose="Body Mass Index is a calculated ratio describing how an individual's body weight relates to the weight that is regarded as normal, or desirable, for the individual's height"
| misuse="Not intended to record information regarding Body Mass Index percentiles - these will be recorded in separate archetypes."
| use="Use to record the Body Mass Index of both adults and children."
| > |
| lifecycle_state = "Author draft"
| > |
other is the *rules* part. The *archetype binding* part binds the archetypes and the elements used within the guidelines. In example 3, two archetypes openEHR-EHR-OBSERVATION.body_weight.v1 and openEHR-EHR-OBSERVATION.height.v1 represent the body weight and height concepts separately. The *elements* within the *archetype binding* part binds the data items in archetype using a unique element path. The *rules* section is the core of the GDL and each rule expresses a set of CIG logic using when/then statements. The local gt code is a unique identifier for the variables and rules and this is used in rule expressions to replace natural language labels. This approach allows users to modify the terminologies from other languages without changing the rule definitions.
Example 3: The definition block of Guideline Definition Language

Example 4 shows the contents of the ontology section. The bindings between the local
gt codes and the reference language labels are maintained in this section. The ontology section also supports external terminology bindings such as SNOMED CT and ICD codes.

```
ontology = (GUIDE_ONTOLOGY) <
  term_definitions = <
    ["en"] = (TERM_DEFINITION) <
      terms= <
        ["gt0000"] = (TERM) <
          text= <"Body Mass Index calculation"> >
        ["gt0001"] = (TERM) <
          text= <"Calculate body mass index"> >
        ["gt0002"] = (TERM) <
          text= <"Weight">      
          description= <"The weight of the individual." > >
        ["gt0003"] = (TERM) <
          text= <"Height/Length">      
          description= <"The length of the body from crown of head to sole of foot." > >
        ["gt0004"] = (TERM) <
          text= <"Body Mass Index">      
          description= <"Index describing ratio of weight to height." > >
        >
      > >
    >
  >
>
```

Example 4: The ontology block of Guideline Definition Language

To summarize the characteristics of the GDL, this allows openEHR archetypes to be combined with rules, which is achieved by creating bindings between the archetype’s data elements and the CDS rule variables. By adopting design ideas from openEHR archetype formalism, the GDL is able to achieve natural language and
reference terminology in a neutrality manner. Each GDL is self-contained and can be reused across different clinical contexts as well as being able to be chained together to express complex rules that are related to each other. In addition, the GDL has rule language neutrality since it uses a set of common rule language features, namely when/then statement expressions, which support common arithmetic calculations, logic operators and functions. Finally, the GDL is able to record the metadata of CDS rules and allows versioning and exchange of CDS rules.

Reference