

Modeling and Tools for Supporting Post-Coordination in ICD-11

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ABSTRACT

The World Health Organization (WHO) is working on the 11th revision of the International Classification of Diseases (ICD-11), which is scheduled to be released in 2017. One of the main goals for the revision process was to make ICD-11 ready to be used with electronic health records and information systems. In order to meet this goal, ICD-11 was designed to have an ontological underpinning, commonly referred to as its "Content Model". Another significant novelty introduced in ICD-11, compared to ICD-10, is that ICD-11 will allow medical coders to enter details, such as severity and temporal course, as modifiers to the main ICD code. To support this kind of post-coordination, we extended the ICD-11 Content Model and the collaborative ICD authoring tool, iCAT, so that ICD developers can specify which post-coordination axes are allowed for each ICD-11 entity, to specify valid values for each axis from a special ICD-11 chapter where value sets are defined, called Chapter X, and to give selected ICD-11 categories logical definitions, so that equivalence of multiple codes and already defined categories can be established automatically.

1 INTRODUCTION

The International Classification of Diseases and Related Health Problems (ICD) is "the international standard diagnostic tool for epidemiology, health management and clinical purposes".¹ The current 10th edition of ICD (ICD-10) was endorsed by the World Health Assembly in 1990 and has been updated periodically over the years. ICD-11 is currently developed as a collaborative effort supported by Web-based software, called iCAT (Tudorache *et al.*, 2011). iCAT is a specially configured and enhanced instance of the popular ontology editor WebProtégé (Tudorache *et al.*, 2013). A key to this revision effort is the, so called, *Content Model* (WHO, 2011), designed to support detailed description of the clinical characteristics of each category, clear relationships to other terminologies and classifications, especially SNOMED-CT, multi-lingual development, and sufficient content so that the adaptations for alternative uses cases for the ICD can be generated automatically.

Starting with the availability of the 11th revision of ICD, users of the classification will be able to code diseases and other health-related conditions by using combinations of codes in accordance with a specific grammar, a practice commonly referred as post-coordination. Post-coordination is an effective way to avoid the combinatorial explosion that would result if ICD were to specify codes for all possible manifestations of health conditions (i.e., pre-coordination). To support post-coordination, we have extended the ICD Content Model and the ICD collaborative authoring tool (iCAT) with new features that allow subject-matter experts to edit post-coordination information. In particular, we have added two new

tabs to iCAT, the *Post-Coordination* tab and the *Logical Definition* tab.

2 MODELING POST-COORDINATION

The first step towards supporting post-coordination in ICD-11 was to extend its ontological foundation, the Content Model, with properties and classes and restrictions between those in a way that allows ICD editors to specify what are all possible ways to post-coordinate each ICD entity.

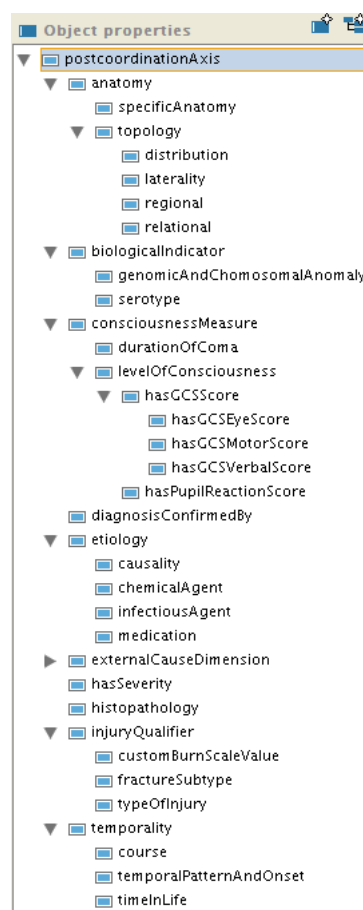


Fig. 1. Screenshot from the Protégé ontology editor, showing the supported post-coordination axes that have been added to the ICD-11 Content Model.

ICD-11 introduces a number of **post-coordination axes** (such as *severity*, *onset*, and *anatomic location*), which we modeled as an object property hierarchy (Figure 1). ICD-11 also introduces a dedicated chapter, **Chapter X**, which will contain possible values for each of these post-coordination axes (Figure 2).

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¹ <http://www.who.int/classifications/icd/en/>

The screenshot displays the iCAT interface for editing the 'Asthma' entity. The 'ICD Categories' pane on the left shows a tree structure where 'Asthma' is selected under 'Diseases of the respiratory system'. The 'Details for Asthma' pane on the right has the 'Post-coordination' tab selected. A table titled 'Linearization / Use' shows various axes (Severity, Course, Temporal Pattern/Onset, etc.) with checkboxes for different ICD-11 codes. For '09. Spec. Lin: Paediatrics', the 'Severity' and 'Temporal Pattern and Onset' axes are checked. Below the table, the 'Severity qualifier' section shows three scale values: 'Mild', 'Moderate', and 'Severe', each with a definition. The 'Temporal Pattern and Onset' section shows two scale values: 'Persistent' and 'Intermittent', each with a definition. The 'Value Hierarchies' and 'Fixed Scales' sections are also visible at the bottom.

Fig. 3. iCAT screenshot showing how one can specify that "Asthma" can be post-coordinated on "Severity" and "Temporal pattern" axes in a hypothetical "Pediatrics" linearization. Also shows that for the "Severity" axis different values of the "MildModerateSevere" scale may be used. Both severity values ("Mild", "Moderate", "Severe") and temporal-pattern values ("Intermittent" and "Persistent") may have "local" Asthma-specific definition.

This is a partial screenshot of the 'Chapter X' details pane in iCAT. It shows a list of scale values for various axes: Severity Scale Value, Course Scale Value, Temporal Pattern and Onset Scale Value, Onset Scale Value, Pattern/Activity/Clinical Status Scale Value, Infectious Agent, Chemical Agent, Medication, Histopathology, Specific Anatomic Location, Time In Life Scale Value, Causality Scale Value, and Laterality Scale Value.

Fig. 2. Partial screenshot of Chapter X in iCAT.

3 EDITING POST-COORDINATION IN iCAT

In addition to modeling changes, we had to extend iCAT in several ways in order to support editing of post-coordination information.

We introduced two new tabs for editing post-coordination details. The **Post-coordination** tab allows iCAT users to specify the valid post-coordination axes that may be used with a given entity in each use case, or "linearization", as it is called in ICD terms. In the same tab, the user is also able to specify the possible value scales or value hierarchies that may be used to post-coordinate the entity along a given axis (see Figure 3). The **Logical Definitions** tab allows ICD-11 authors to give an existing ICD entity a logically necessary and sufficient definition by selecting a superclass and specifying values for some allowed post-coordination axes of that superclass.

Another modification was to configure iCAT to show appropriate tabs with appropriate content for editing the details for entities in **Chapter X**. Unlike in other chapters, for entities in Chapter X, such as *Chronic*, iCAT users can only edit *title*, *definition*, *synonyms* and *external definitions* in the **Title & Definition** tab, can define its *base index terms* in the **Terms** tab, and specify which linearizations will the entity be part of in the **Classification Properties** tab.

We have also added a top level tab, called **Scales**, designed for the editing of predefined value scales that can be used to define possible values for the *severity*, *course* and *onset* post-coordination axes. The definition of the scale values in these scales can be overwritten at each ICD entity. This tab is available only to WHO.

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