

# Standardizing the Unit of Measurements in LOINC-Coded Laboratory Tests Can Significantly Improve Semantic Interoperability

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## 1. Introduction

Within healthcare environments, diagnostic and clinical data comes from many different systems, which frequently leads to an inconsistent presentation of important information. Controlled standard terminologies such as Logical Observation Identifiers Names and Codes (LOINC), allow some of the data inconsistency problems to be resolved. In the German Medical Informatics Initiative (MI-I), LOINC is used for sharing laboratory data across different departments and different university hospitals [1], [2]. Therefore, a list of 300 frequently used LOINC codes was composed, enabling a common basis for the mapping of site-specific terms and measurements to LOINC at all participating sites.

Despite being a standardized coding system LOINC has been shown to leave some ambiguity in the tests coded with it, particularly by defining a “kind of quantity/property” instead of the unit of measurement itself [3], as shown in Table 1. In this short paper inter-mapping variability arising from the ambiguous property definition is investigated.

**Table 1.** Two different LOINC Terms for similar measurements, differing only in their specified **property**.

LOINC Code	LOINC Term	Example Unit
2345-7	Glucose <b>[Mass/volume]</b> in Serum or Plasma	mg/dL
14749-6	Glucose <b>[Moles/volume]</b> in Serum or Plasma	mmol/L

## 2. Methods

In the HiGHmed consortium participating university hospitals are required to map their local laboratory terms to LOINC based on the agreed TOP300 list. The mapping was

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done by domain experts, either using RELMA [4] or the LOINC web interface. Afterwards, site-specific mapping tables, with different locally used naming conventions, were joined by using Inner Join so only matching rows were included in further work.

The unique identifiers were LOINC codes, so we could identify different test names and additional information including the unit of measurement that were associated with the same concepts. Entries were evaluated for discrepancies which were further analyzed.

### 3. Results

Conflicts in the resulting table were found both for the name and also for the unit of measurements assigned to the same code. For 118 out of 186 entries the same unit was defined at both sites, whereas 67 disparities could be divided into two categories:

- 1) Different laboratories used two slightly different versions of the same unit of measurements. Table 2 shows “sec” and “sek” being used for time points.
- 2) The unit is reported in different granularities e.g. gram per liter versus milligram per milliliter. Examples can be found in rows two and three of Table 2.

**Table 2.** Examples of disparate site-specific annotations mapped to the same LOINC

LOINC Code	Name (Site 1)	Name (Site 2)	Unit (Site 1)	Unit (Site 2)
3243-3	Thrombinzeit	Thrombinzeit (CP)	sek	sec
3013-0	Thyreoglob., hTG	Thyreoglobulin (S)	µg/l	ng/ml
19113-0	IgE	Immunglobulin E (HP)	IU/ml	kU/l

### 4. Discussion and Conclusion

Differences in site-specific reporting are expected but can’t be eliminated solely by mapping to LOINC. Therefore, using Unified Code for Units of Measure (UCUM) can significantly improve semantic interoperability. Employing UCUM would not only eliminate minor disparities as described in category 1) but could also enable the automated conversion between related units differing in granularity [5].

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