SLOVENSKI STANDARD
SIST ENV 12381:2003

01-oktober-2003

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Health care informatics - Time standards for healthcare specific problems

Medizinische Informatik - Zeitnormen für spezifische Probleme im Gesundheitswesen

Informatique de santé - Représentation du temps dans le domaine de la santé

Ta slovenski standard je istoveten z: ENV 12381:1996

ICS:

35.240.80	Uporabniške rešitve IT v zdravstveni tehniki	IT applications in health care technology

SIST ENV 12381:2003   **en**

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EUROPEAN PRESTANDARD

PRÉNORME EUROPÉENNE

EUROPÄISCHE VORNORM

ENV 12381

September 1996

ICS 11.020; 35.240.60

Descriptors: data processing, information interchange, medicine, data representation, hours:time

English version

Health care informatics - Time standards for healthcare specific problems

Informatique de santé - Représentation du temps dans le domaine de la santé

Medizinische Informatik - Zeitnormen für spezifische Probleme im Gesundheitswesen

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CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

Central Secretariat: rue de Stassart,36 B-1050 Brussels

Ref. No. ENV 12381:1996 E

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Foreword

This European Prestandard has been prepared by Technical Committee CEN/TC 251 "Medical Informatics", the secretariat of which is held by IBN.

According to the CEN/CENELEC Internal Regulations, the national standards organisations of the folloxing countries are bound to announce this European Prestandard: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Introduction

Time is an important variable in healthcare, and standards are needed about how to represent information in with explicit references to time. This European Prestandard is a first contribution to this harmonization process, focusing on "representation" and "explicit reference".

Indeed, a system for Time-Standards must have as a minimum requirement the capacity to order temporal facts (*situations, events, episodes*) in three major ways, independent of any specific ontology of time itself:

- by relating situations to a calendar,
- by relating situations to "reference" situations
- by relating events together in "before- and after-" chains

The main reason for this threefold organization is that our everyday temporal discourse contains a variety of expressions that only with a certain artificiality can be regimented into a uniform style of analysis.

The purpose of this European Prestandard is to enhance, in a perspective of machine-machine and man-machine communication, the generation of statements that are guaranteed to be understood unambiguously with respect to the time-related expressions that are embedded within them.

The purpose of this European Prestandard is not to develop a full-blown temporal logic, but a standardized way of representing time-related expressions, such that all kinds of questions about the temporal organization of *situations* can be answered on the basis of the information available. Nor is it the intention of the framework presented here to provide a means to interpret the information in its original format. Interpretation of the source information is the task of the provider of information itself. The framework presented in this document allows information providers to express their time-related information in such a way that the intended meaning can be unambiguously understood by a receiver.

This of course requires the use of a "restricted", regimented model or language, allowing the disambiguation of many time-related expressions uttered in natural language. The model (language) presented in this document is restricted enough to allow such disambiguation for time-related expressions in "traditional" medical language, but is not expressive enough to account for all time-related linguistic phenomena that can be encountered in natural language.

This European Prestandard provides representational tools for "explicit" time-related information. It does not allow (nor encourage) the ad hoc interpretation of implicit temporal information. In an expression such as "diabetes since childhood", "since childhood" is an explicit temporal reference for the diabetes, but the implicit information what "childhood" might mean (e.g. starting at the age of 2 years ?), is not addressed. However, the framework presented in this document has enough expressive power to allow a specific provider of information to state explicitly what his understanding is of "childhood".

This European Prestandard describes some conformance characteristics by means of which developers of health care information systems can label specific modules of their systems as to the

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degree they are compliant with the standard. Although the framework itself does not deal with temporal reasoning, the conformance characteristics can be used to evaluate to what level temporal reasoning is possible with the information collected in a given system.

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1 Scope

This European Prestandard specifies a set of representational primitives and semantic relations required for an unambiguous representation of explicit time-related expressions in medical informatics. This Prestandard does not introduce or force a specific ontology of time, nor does it force the use of a fixed representation scheme for such an ontology. Rather this Prestandard provides a set of principles for syntactic and semantic representation that allow the comparability of specific ontologies on time, and the exchange of time-related information that is expressed explicitly.

This European Prestandard is applicable to

(1) developers of medical information systems in which the need is felt to have explicit time-related concepts for internal organization (e.g. temporal data bases, temporal reasoning systems),

(2) information modellers or knowledge engineers building models for the systems mentioned in (1),

(3) experts involved in the development of semantic standards on precise subdomains in health care where time-related information need to be covered, (e.g. in the study of Pathochronology, i.e. the discipline dealing with the time course of specific diseases)

(4) developers of interchange formats for messages in which time-related information is embedded.

This European Prestandard is not intended to be used directly for:

(1) representing what is true in time

(2) reasoning about time

(3) representation of metrological time (which is covered in other standards).

2 Normative references

This European Prestandard incorporates by dated or undated reference, provisions from other publications. These normative references are cited in the appropriate places in the text, and the publications are listed hereafter. For dated references, subsequent amendments and revisions of any of these publications apply to this European Prestandard only when incorporated in it by amendment and revision. For undated references, the latest edition of the publication referred to applies.

ISO 8601 : 1988	Data elements and interchange formats - Information interchange - Representation of dates and times
ISO 31-1 : 1992	Quantities and units. Pt1, Space and Time
ISO 1087 : 1990	Vocabulary of terminology.

3 Terms and definitions

For the purposes of this standard, the following terms and definitions apply (listed in a logical order):

3.1   **situation**
phenomenon occurring (or having the potential to occur) at or over a time in a given world context

NOTE: (1) *situations* cover phenomena which may occur in past, present or future time.

(2) This European Prestandard applies both to the representation of actual phenomena occuring in the real world (eg registrations in medical records), as to the description of concepts (eg medical knowledge bases)

EXAMPLES: "The patient suffered from pain which occured over night", "pain occuring over night",

3.2 time interval

portion of time of which the duration in a given context is considered to be significant and relevant

3.3 time point

portion of time of which the duration in a given context is considered to be insignificant or irrelevant

NOTE: This European Prestandard does not specify any regulations on what entities should occupy *time points*, and what entities should occupy *time intervals*. Decisions of this kind are explicitly to be made by the user of this prestandard (Chapter 5). As a consequence, *temporal references* such as "Friday the 13th" may refer to a *time point* or a *time interval*, depending on the context.

3.4 episode

situation considered to occupy a *time interval*

NOTE: (1) Whether a *situation* is to be considered an *episode* or an *event*, is a decision taken by the provider of the information, based on its perception of the phenomenon in a given context.

(2) It is possible to further subcategorize *episodes* into "states", "culminations", "processes", "actions", or other conceptual entities that can be defined using additional conceptual aspects describing particular properties of each of the various *episodes*. However there is no need to do so within the scope of this European Prestandard.

EXAMPLES: a patient's stay in the hospital, the "episode of care" related to a medical problem.

3.5 event

situation considered to occur at a *time point*

3.6 predication

representation of a *situation* in a language

EXAMPLE: "The removal of Mr Jones' appendix on 21 July 1994, at 9 o'clock in the morning."

3.7 temporal reference

component of a *predication* representing information related to time

EXAMPLES: "on 1994-07-21", "at 9 o'clock", "on 1994-07-21 at 9 o'clock".

3.8 propositional clause

component of a *predication* to which *temporal references* implicitly or explicitly refer

EXAMPLE: in the expression "taking syrup three times a day for 2 weeks", the *propositional clause* is "taking syrup". To it are attached the *temporal references* "three times a day" and "for 2 weeks".

NOTE: (1) The term *propositional clause* is used here in a broader sense than in formal logic where a proposition denotes a statement on what is true in a given world. In the context of this prestandard, *propositional clauses* do not impose a truth-value on the phenomena that are represented.

(2) This standard allows for a recursive representation of information related to time (see Informative Annex A for a formal description). In expressions such as "severe headache lasting for half an hour after each meal", both "severe headache" and "severe headache lasting for half an hour" are *propositional clauses*, each at a different level in the recursion. A *propositional clause* that is at the deepest level of recursion, i.e. to which no *temporal references* are attached, is called *propositional clause zero*. In this example: "severe headache" is *propositional clause zero*.

3.9 ambiguous temporal reference

temporal reference whose *temporal link* with the *propositional clause* of the *predication* is ambiguous, or which does not unambiguously refer to a unique, identifiable *time point* or *time interval* on a calendar.

NOTE: (1) In the *predication* "He died on Monday", "on Monday" is a *time point expression*. Somebody can only die once. In the *predication* "He operates on Monday", "on Monday" may be considered a *frequency expression*. However, in the context of this standard, the meaning of a *propositional clause* is not known, and as a consequence, "on Monday" cannot unambiguously be identified as *a time point expression* or a *frequency expression*, unless the provider of the information is explicit about this. Hence, it is an *ambiguous temporal reference*.

(2) Ambiguity is in this context related to "lacking knowledge" on the exact interpretation of a *predication*, i.e. the intended meaning by the provider of the information is not known. Phenomena that are "planned" for the future do not necessarily introduce ambiguity. In an expression such as "He will probably operate next Monday", the *temporal reference* "next Monday" is not ambiguous.

(3) From the definition it follows that it is specifically the nature of the *temporal link* that makes a *temporal reference* ambiguous or not, and not the fact whether *the temporal reference* is explicitly categorised as being a *time point* or a *time interval*. In the expression "He will probably operate next Monday", "Monday" might indeed as well be a *time point* as a *time interval*.

3.10 temporal link

component of a *temporal reference* capturing the semantic relation in a *predication* between the *propositional clause* and the *temporal expression*

NOTE: In natural language, the *temporal link* may be grammaticalized with prepositions or other constructs, such as in "on Monday". Often, the link is not expressed explicitly, as in "tomorrow". In formal representations compliant to this standard, the *temporal link* needs to be represented explicitly, or should be unambiguously derivable from a data model.

3.11 basic temporal link

temporal link specifying purely time-related information

EXAMPLE: has-occurrence, has-duration (Subclause 4.3)

3.12 complex temporal link

temporal link composed of a *basic temporal link* and an embedded *propositional clause*

NOTE: Complex temporal links can be used to express the contents of relational data bases according to the provisions of this European Prestandard.

EXAMPLE: The *predication* "Severe headache this morning" can be analysed into the *propositional clause* "severe headache" and the *temporal reference* "this morning". In a database management system, such *predications* can be represented in a table with fields "ProblemId", "Problem" and "TimeOfHappening":

ProblemId	Problem	Time of happening
I1	severe headache	this morning
I2	ingestion of acetylsalicylic acid	immediately after I1
...		

In this table, the contents of the "Problem" column refer to *situations*, and hence are to be considered *propositional clauses* and the contents of the "Time of Happening" column are all *temporal references*.

Often, also the time of recording of problems is also recorded as useful meta-information. According to the model above, this should be done by adding two records in the table:

I3	recording of I1	1994-07-01:18:00:32
I4	recording of I2	1994-07-01:18:00:35

In fact, this could be repeated for each record, even for the records in which the recording of the recording of the ... is recorded. Because only the recording time of a problem is of interest, and not the recording event itself, the above scheme is simplified by adding an additional field, labeled TimeOfRecording, which is a *complex temporal link*.

ProblemId	Problem	Time of happening	Time Of Recording
I1	severe headache	this morning	1994-07-01:18:00:32
I2	ingestion of acetylsalicylic acid	immediately after I1	1994-07-01:18:00:35
...			

Other examples of *complex temporal links* are: StartDateOfSampleCollection (laboratory context), DateOfBirth (administrative context), StartDateOfProblem, EndDateOfProblem (clinical history or diagnostic module of electronic medical record systems), ...

3.13 temporal expression

component of a *temporal reference* specifying a *time point*, a *time interval* or any allowed combination of *time points* and *time intervals*.

NOTE: This European Prestandard does not imply any restrictions on what combinations of time points and time intervals are "allowed" as this depends entirely on the ontology of time defined in a particular context. However, such an ontology can only be claimed to conform to this European Prestandard when such combinations can be represented by the temporal expressions described in this document.

3.14 absolute temporal expression

temporal expression whose exact meaning in a given context can directly be derived from the *temporal expression* itself

EXAMPLES: "9'oclock", "1994-04-12", "Christmas"

NOTE: "exact meaning" refers here to the fact that *absolute temporal expressions* (by definition) contain all the information required to relate the *situation* to a calendar.

3.15 relative temporal expression

temporal expression whose exact meaning in a given context can only be derived from the *temporal references* of the *predications* referred to in the *temporal expression*

EXAMPLE: "headache starting after eating chocolate". When the headache starts, can only be known if it is known when the eating of chocolate takes place.

NOTE: the "relativeness" or "absoluteness" of a *temporal expression* does not imply any qualitative preference. For pure temporal reasoning issues, *absolute temporal expressions* are to be preferred, but for medical reasoning, this is not true. Reducing the two *predications* "eating chocolate at three o'clock" and "headache after eating chocolate", to

"headache after three o'clock" would imply a dramatic loss of information from the clinical point of view.

3.16 deictic temporal expression

temporal expression whose exact meaning in a given context only can be derived from information outside that context

EXAMPLE: expressions such as "now", "yesterday", "last Monday", "in three weeks", can only be given precise meaning if the time of utterance is known.

3.17 time point expression

temporal expression denoting a *time point*

3.18 time interval expression

temporal expression denoting a *time interval*

3.19 duration expression

temporal expression referring to the length of a *time interval*

EXAMPLES: "three years", "a long time"

3.20 rate expression

temporal expression denoting the change of a property over a *time interval*

NOTE: The change of the property is to be considered the *situation* on which information related to time is given.

EXAMPLE: for the variable "velocity": "3 m/s".

3.21 frequency expression

temporal expression denoting the number of repetitions of a phenomenon during a *time interval*

NOTE: (1) A frequency may be considered a special case of a rate ("number rate").

(2) The time interval does not need to be represented explictly as is the case in some of the following examples.

EXAMPLE: "twice a day", "every 5 minutes", "often", "frequently", "after each meal", "never" "always".

3.22 time series expression

temporal expression denoting the occurrence of a *situation* in a series of *time points* or *time intervals*

3.23 temporal comparator

specifier of the temporal relation expressed by the *temporal link* between the *propositional clause* and a *temporal expression*

EXAMPLE: temporal comparators that may be added to the temporal link has-occurrence are amongst others: "AT, BEFORE, AFTER,..." (Subclause 4.5)

3.24 temporal operator (synonym: temporal function)

component of a *temporal expression* further specifying or restricting its exact meaning

EXAMPLE: StartMoment of a *time interval*, FirstElement of a *time series*.