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Health Informatics — Requirements for a knowledge base for clinical decision support systems to be used in medication-related processes

Informatique de santé — Exigences relatives aux bases de connaissances pour systèmes d'aide à la décision clinique à utiliser dans le cadre des processus liés aux médicaments

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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This document was prepared by Technical Committee ISO/TC 215, *Health Informatics*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 251, *Health informatics*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

0.1 Safe and effective usage of medicines is important

When a patient gets his/her medicines prescribed and dispensed, it is not only important that the patient gets the correct medicine and that ordering and reimbursement is supported by using a Medicinal Product Dictionary (MPD), but it is also important that the medicine is safe and effective with respect to the specific situation of the patient.

Because an MPD contains just the identification of the medicines, it is important that an MPD is enriched with clinical decision support (CDS). The aim of CDS is to help prescribe and dispense the medicine that fits the patient's personal situation in respect of effectiveness and toxicity of the medicine. Based on a knowledge base combined with the patient's situation such as comedication, comorbidity, age, laboratory values, diet, allergy, a healthcare professional can be warned for likely side effects or ineffectiveness, and change the therapy.

0.2 Need for a standardized knowledge base

To achieve the aim described in Clause 0.1, there are several success factors, in literature, referred to as the 'five rights'[28]:

— The *right information:* the information should be evidence based and give concrete guidance for action.

— To the *right person:* the alerts should be presented to the person who is the most likely one to take action (e.g. the clinician, the pharmacist, the caretakers).

— In the *right CDS intervention format:* such as an alert, a request to measure certain laboratory parameters, or an answer to a clinical question.

— Through the *right channel:* this can be the clinical information system like the pharmacy information system, or a web-browser that makes available the data of the knowledge base.

— At the *right time in workflow:* for example, during prescription or dispensing, or in batch at night to have certain data available the next morning.

To provide the *right information*, a knowledge base is necessary; and also providing the knowledge to the *right person,* the *right format* and at the *right time in the workflow* is part of a knowledge base, as far as it concerns the 'knowledge' of it.

There are clinical decision support systems (CDSSs) that provide this knowledge, but Helmons stated that there are several barriers for implementing a CDSS, one of them being 'content issues' like: 'Typically installed without any validated decision rules, which have to be developed and/or validated in each individual institution (also called 'having to reinvent the wheel')'[26].

Therefore, a (technically) validated, standardized knowledge base is the recommended basis for CDS.

The needs for a standardized knowledge base are as follows:

— There is an overwhelming amount of data in the summary of product characteristics (SPC), guidelines, literature and handbooks. Prescribers, physicians and pharmacists cannot easily find what to do for a certain drug combination or drug-disease combination. The most relevant data and accompanying recommendations are curated from literature and put in rules in a knowledge base.

— Information about the availability, safety and efficacy of medication to be used for the prescription by physicians is often outdated even when the information is available electronically (e.g. in the drug interaction management system in a doctor's office). Linking the information from the Medicinal Product Dictionary to a CDSS that uses a validated, standardized knowledge base makes sure that during prescribing/dispensing up-to-date information is always used.

— While the population is still growing, people become older and have more comorbidity and polypharmacy, the need for smart knowledge base rules that provide the basis for generating alerts with a high specificity and sensitivity, is increasing.

— Besides assuring that the most precise and current information is to be used in the knowledge base for the benefits of the patient, this specification will also provide a basis or 'handles' how to map the information to the MPD, the IDMP vocabulary and their own local data in EHR and pharmaceutical domains.

0.3 Focus — A knowledge base for drug-related problems that cohere with the intended drug use

This document is about a standardized knowledge base to be used in medication-related processes. In the context of this document, this means a knowledge base that has its focus to enhance decisions and actions in drug-related problems that cohere with the intended drug use, namely once a drug has been chosen, in any domain of prescribing, dispensing, administering of the drug and monitoring the patient.

Aspects like choosing the right drug according to guidelines and patient coaching for the correct usage are not included in the scope of this document (which does not mean that the requirements that are described in this document are not useful for knowledge bases with such kind of scopes).

0.4 Why this document: general principles versus medication specific aspects for developing a knowledge base

Describing how a structured, standardized knowledge base should be developed, what are the criteria to take into account, is a rather general process. As such it is not specific for medication processes. Assessing literature and developing rules is also applicable for other domains.

In this respect, this document contains two sorts of requirements. First, there is the overarching level, not specific for medication processes. This includes, for example, the requirements for selecting and assessing literature, updating the knowledge base. Secondly, there is a medication-specific level in this document. This includes the area to which the requirements are applied: if the requirement is to determine which kind of people will assess the rules, the document mentions the disciplines in healthcare: such as pharmacists, physicians.

0.5 Use cases

The use cases for a knowledge database for drug-related problems are primarily decision support based on validated, standardised rules to enhance decisions in the process of:

— prescribing

— dispensing

— administering

— monitoring the therapy of the patient.

Besides that, decision support based on a standardised knowledge base can also be useful for (not exhaustive):

— travel medicines

— health counselling.

0.6 Target users of this document

The target users of this document for a knowledge base in medication-related processes include:

— Academic organisations in the field of pharmaceutical healthcare, that develop knowledge bases for medicines;

— Vendors and other parties developing CDSSs (based on knowledge bases as described in this document), like (not exhaustive):

  — clinical or pharmacy information systems

  — hospital ward information system

  — doctor‘s office information systems

  — decision aids for patients.

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1 Scope

This document specifies the requirements for developing a knowledge base for drug-related problems that cohere with the intended drug use, to be used in rule-based clinical decision support systems (CDSS), such as the criteria for selecting a raw data source and the quality criteria for the development and maintenance for the rules or clinical rules for drug safety. It also describes the process of how to develop a knowledge base, the topics to be considered by the developers of a knowledge base, and it gives guidance on how to do this.

This document gives guidelines for the development of a knowledge base:

— with rules to enhance decisions and actions in drug-related problems that cohere with the intended drug use;

— which can be used by all kinds of healthcare professionals, such as those who prescribe, dispense, administer or monitor medicines;

— which can be used in every care setting, including chronic and acute care, primary and specialized care;

— which is a repository of evidence/practice bases rules, assessed by experts;

— which is meant to be used in conjunction with a medicinal product dictionary;

— whose knowledge is structured in rules and therefore to be used in the type of rule-based CDSS.

This document does not:

— describe the exact content of a knowledge base i.e. the outcome of the process of developing rules.

— provide the requirements for a clinical decision support system, the software that uses the knowledge base combined with the patient's data, and presents the outcome of the rules to the healthcare professional. These requirements are described in ISO/DTS 22703[1)].

— give the requirements for non-medication knowledge bases. Some aspects of the requirements in this document are general in nature and applicable to other kinds of knowledge bases, but this document does not address all of the requirements of non-medication knowledge bases.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 11615, *Health informatics — Identification of medicinal products — Data elements and structures for the unique identification and exchange of regulated medicinal product information*

ISO/TS 19256, *Health informatics — Requirements for Medicinal Product Dictionary Systems for Healthcare*

1) Under preparation. Stage at the time of publication: ISO/DTS 22703.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
clinical decision support
type of service that assists healthcare providers in making medical decisions, which typically require input of patient-specific clinical variables and provide patient-specific recommendations

[SOURCE: ISO/TR 14639-2:2014, 2.8, modified — Note 1 to entry has been deleted.]

3.2
clinical decision support system
software designed to be a direct aid to clinical decision-making, in which the characteristics of an individual patient are matched to a computerized clinical knowledge base, whereafter patient-specific assessments or recommendations are presented to the clinician or the patient to aid in the process of making evidence based clinical decisions

[SOURCE: Ida Sim e.a., *Clinical decision support systems for the practice of evidence-based medicine*, J Am Med Inform Assoc. 2001 Nov-Dec; 8(6): 527–534, modified]

3.3
dispensing
process by which an individual healthcare provider takes in a prescription, assesses that prescription, selects the prescribed medicinal product and delivers that medicinal product to the subject of care or their representative

Note 1 to entry: In most cases, but not necessarily always, the individual healthcare provider concerned will be a Pharmacist.

[SOURCE: ISO/TS 19256:2016, 3.9]

3.4
dispense record
record of dispensed medicinal product and dispense process

Note 1 to entry: Note 1 to entry: Dispensed medicinal product includes the actual product dispensed identifiers, brand, type, form, quantity etc. Dispense process record includes details of the delivery method, date and recipient (where this is not the subject of care) and the dispenser. The ability to record a comment where assessments of prescriptions are undertaken might also be part of this record.

[SOURCE: ISO/TS 19256:2016, 3.10]

3.5
dose instructions
instructions pertaining to the medication, which describe the amount of medication per dose, method of administration, the frequency or interval of dose, associated instructions for dosing or skipped doses, and other associated parameters necessary for appropriate administration of the medication

[SOURCE: ISO/TS 17251:2016, 2.1]

3.6
drug-related problem
occurrence related to the drug therapy of the patient which (can) lead to a suboptimal outcome of the treatment

3.7
electronic health record
repository of information regarding the health of a subject of care, in computer processable form

[SOURCE: ISO/TR 20514:2005, 2.11, modified — Note 1 to entry has been deleted.]

3.8
identifier
sequence of characters, capable of uniquely identifying that with which it is associated, within a specified context

[SOURCE: ISO/TS 19256:2016, 3.15]

3.9
knowledge base
facts, information and skills acquired through research, experience, reasoning or education on a specific topic as a set of declarative, hierarchical organization of such statements, and relationships between declarative statements, which serves as the underpinning of decision support systems

[SOURCE: ISO/TS 19256:2016, 3.19 modified]

3.10
medicinal product
substance or combination of substances that may be administered to human beings (or animals) for treating or preventing disease, with the view to making a medical diagnosis or to restore, correct or modify physiological functions

Note 1 to entry: A medicinal product may contain one or more manufactured items and one or more pharmaceutical products.

Note 2 to entry: In certain jurisdictions a medicinal product may also be defined as any substance or combination of substances which may be used to make a medical diagnosis.

Note 3 to entry: Medicinal Product MPID XXXX87456 Slaapdiep tablet / Slaapdiep20 mg tablets National – has a name dedicated to a specific jurisdiction (the code number is just an illustration, not a real identifier).

[SOURCE: ISO/TS 19256:2016, 3.24]

3.11
medicinal product dictionary
consistent representation of medication concepts (set of identifiers) at various levels of detail and with meaningful relationships between the concepts, in order to support use cases in healthcare in which medication plays a role

[SOURCE: ISO/TS 19256:2016, 5.5, modified]

3.12
pharmaceutical product
qualitative and quantitative composition of a medicinal product in the dose form authorized for administration by a regulatory authority, and as represented with any corresponding regulated product information

Note 1 to entry: A medicinal product can contain one or more pharmaceutical products.

Note 2 to entry: In many instances, the pharmaceutical product is equal to the manufactured item. However, there are instances where the manufactured item undergoes a transformation before being administered to the patient (as the pharmaceutical product) and the two are not equal.

[SOURCE: ISO/TS 19256:2016, 3.30, modified — Note 3 to entry has been deleted.]

3.13
prescribing
process of creating a prescription

[SOURCE: ISO/TS 19256:2016, 3.33]

3.14
prescription
direction created by an authorized healthcare person, to instruct a dispensing agent regarding the preparation and use of a medicinal product or medicinal appliance to be taken or used by a subject of care

Note 1 to entry: The term "prescription" alone is best avoided as it is colloquially used at random for the following terms: new prescription message, prescription set and prescription item. Further, it is also used to describe a prescription form. The use of the terms prescription set, prescription item and new prescription message where appropriate is recommended.

[SOURCE: ISO/TS 19256:2016, 3.34]

3.15
decision rules
logic used to represent the facts to support a logical decision based upon knowledge

[SOURCE: *Handbook. Guide to the principles and desirable features of clinical decision support systems*, Council of Standards Australia, Sydney 2007]

3.16
substance
matter of defined composition that has discrete existence, whose origin may be biological, mineral or chemical

Note 1 to entry: Substances can be single substances, mixture substances or one of a group of specified substances. Single substances are defined using a minimally sufficient set of data elements divided into five types: chemical, protein, nucleic acid, polymer and structurally diverse. Substances may be salts, solvates, free acids, free bases or mixtures of related compounds that are either isolated or synthesized together. Pharmacopeial terminology and defining characteristics will be used when available and appropriate. Defining elements are dependent on the type of substance.

Note 2 to entry: Discrete existence refers to the ability of a substance to exist independently of any other substance. Substances can either be well-defined entities containing definite chemical structures, synthetic (i.e. isomeric mixtures) or naturally occurring (i.e. conjugated oestrogens) mixtures of chemicals containing definite molecular structures, or materials derived from plants, animals, microorganisms or inorganic matrices for which the chemical structure may be unknown or difficult to define. Substances may be salts, solvates, free acids, free bases and mixtures of related compounds that are either isolated or synthesized together.

[SOURCE: ISO/TS 19256:2016, 3.41]

4 Abbreviations

For the purposes of this document, the following abbreviations apply.

CDS	clinical decision support
CDSS	clinical decision support systems
EHR	electronic health record
HL7	Health Level Seven
ICD	international classification of diseases

ICH	international council for harmonization of technical requirements for pharmaceuticals for human use
ICPC	international classification of primary care
ICSR	individual case safety report
IDMP	identification of medicinal products
LOINC	logical observation identifiers names and codes
MPD	medicinal product dictionary
S[m]PC	summary of product characteristics
SNOMED-CT	systematized nomenclature of medicine – clinical terms

5 Positioning of a CDS knowledge base

5.1 Knowledge in healthcare

In healthcare, there are a lot of different processes that can be supported by CDS. 'CDS' is therefore a broad term that includes all kinds of support for enhancing health-related decisions and actions, with pertinent, organized clinical knowledge and patient information to improve health and healthcare delivery.

Examples are CDS for overall efficiency, identifying disease early, aid in accurate diagnosis, for preventive care, for treatment or monitoring and follow-up, or for optimization of drug therapy from different perspectives like quality, cost-efficiency or preventing drug-related problems. CDS for optimising drug therapy often support the check for known drug allergies of patients, comparison of drug and diagnostic test results to ensure that the right drug at right doses are prescribed, alerts in case of drug–drug interactions, suggest medical alternatives, drug doses, routes, and frequencies, duplicate orders.

5.2 Knowledge for drug-related problems that cohere with the intended drug use

As mentioned in 5.1, one of the scopes of a CDS can be to prevent drug-related problems.

In literature, there are different descriptions of what belongs to 'drug-related problems'. Mostly issues like adverse reactions, drug choice problems, dosing problems, drug use problems and interactions are mentioned. Others classify drug-related problems as 'intrinsic' (belonging to the drug) or 'extrinsic' (errors concerning prescribing, transcription, dispensing, administration [including non-compliance]) and 'across settings' (errors occurring on the interface between different healthcare settings), with several sub divisions per class). This shows that these definitions are ambiguous.

For this document, a general definition of 'drug-related problems' is chosen which has its focus on problems once a drug has been chosen, in any domain of prescribing, dispensing, administering of the drug and monitoring the patient.

A drug-related problem is an occurrence related to the drug therapy of the patient which (can) lead to a suboptimal outcome of the treatment. The aim of detecting drug-related problems is firstly to minimize the risk of unintended harm or discomfort associated with the use of a product and secondly to maximize the effectiveness of the drug used by the patient. This includes not only rules about how to optimize the therapy of the drug once it will be used, but also recommendations if the drug itself is non-optimal (either obsolete, or not effective enough given the patients' characteristics).

This definition has its focus on drug-related problems that cohere with the intended use of a drug. Aspects like choosing the right drug according to guidelines (efficacy) and patient coaching for the correct usage are not included in this definition.