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Health informatics — Requirements for medication safety alerts

Informatique de santé — Exigences relatives aux alertes de sécurité sur les 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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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

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

To improve the quality and safety of patient care in digital work-flow environments, computer assisted clinical decision support systems (CDSSs) have been emphasized and implemented in healthcare organizations and pharmacies, especially focusing on medication safety.

CDSSs for medication safety have been developed and used in many countries as an essential component for decision support for clinicians in prescribing, dispensing and administering medication in connection with an electronic health record (EHR), computerized physician order entry (CPOE) system or pharmacy electronic health record (PEHR) and digitized knowledge bases.

Depending on the availability of knowledge bases and functionalities, CDSS can be classified into four types[12]:

Type 1 CDSS: provides categorized information that requires further processing and analysis by users before a decision can be made. This type of decision support includes direct access to relevant information, such as web-based access to current rules for travel inoculation.

Type 2 CDSS: presents the clinician with trends of a patient's changing clinical status and alerts clinicians to out-of-range assessment results and intervention strategies. Clinicians are prompted to review information related to the alerts before arriving at a clinical decision.

Type 3 CDSS: uses deductive inference engines to operate on a specific knowledge base and automatically generate diagnostic or intervention recommendations based on changing patient clinical condition, with the knowledge and inference engines stored in the knowledge base. These systems include systems that consider the disease and medication of the patient and whether these have contraindications for new medication. These systems require computer-readable rules and an underlying computer EHR system that is also computer processable. They also require computerized terminological representation of clinical concepts.

Type 4 CDSS: uses more complex knowledge management and inference models than the other three decision support types. These systems include case-management reasoning, neural networks and statistical discrimination analysis to perform outcome or prognostic predictions. Such systems possess self-learning capabilities and use fuzzy set formalism and similarity measures or confidence level computation as mechanisms to deal intelligently and accurately with uncertainty.

Among the four types of CDSS, type 3 has been focused on developing CDSS for medication safety alerts in the countries where EHRs are in use, though type 4 is available in some countries.

Since the primary purpose of a medication CDSS implementation is the prevention of potential harmful effects of medication or errors, all types of CDSS have been designed to have the functionality of alerting or warning clinicians in a prospectively actionable fashion for all settings.

However, the desired outcome of prevention of harmful drug therapy with the use of CDSS for medication safety has not been clearly defined. This can be attributed to factors such as poor and varied stratification (mainly due to lack of clear consensus on terminology and rules) of safety risk warnings or alerts. In addition, alert fatigue (the result of frequent alerts to clinicians which are not clinically significant or tailored to speciality interests) is known to be one of the major factors contributing to alert overrides, which can result in serious clinical consequences.

Unclear content and verbose language in medication safety alerts can also be barriers to clear communication with clinicians of the clinical significance of potential safety risks.

In addition, since the alerts are linked to the embedded CDSS knowledge base through specifically designed algorithms, the differences between algorithms to produce alerts, even though they are based on the same knowledge base, can be another inhibiting factor in getting uniform and maximal benefit from safety alert systems operating on the same patient population with the same clinical condition or situation.

In the USA, a number of EHR and CPOE vendors, as well as several drug knowledge bases, are in use with wide differences in content, alert types and displays. Medication safety alerts in computerized information systems have typically been developed for pharmacy software, often in connection with pharmacy benefit management, the requirement for a prospective drug utilization review (DUR) programme for outpatients using a prescription filling service in community pharmacies, or both. For prospective DUR programmes, the potential medication problem types for medication safety alerts were defined by federal regulation and have been used for developing CDSS for pharmacy practitioners and CPOE by system vendors.

In the Republic of Korea, a number of drug knowledge bases (in the form of CDSS) with the functionality of safety alerts which are developed by system vendors and pharmacy benefit managers of national health insurance bodies are in use, mostly benchmarking the prospective DUR programme in the USA. However, they are not detailed enough to meet individual use cases and thus healthcare organizations resort to commercial vendors for more in-depth and user-friendly coverage of medication alert content.

In other countries, various types or methods for providing medication safety alerts in connection with digitized knowledge bases have been developed and implemented in digitized health information systems. However, there are no internationally or regionally standardized requirements for improving patient safety by alerting healthcare professionals to potential safety risks.

Given the wide variability of medication safety alert content and implementation approaches across different system vendors and drug knowledge bases, there is a need for medication alert standardization both nationally and internationally.

Stakeholders can use this document for developing common and structured medication safety alert systems to improve patient safety.

The actors included in the scope of this document include, but are not limited to:

— healthcare organisations which deploy EHR or PEHR systems incorporating medication safety alerts;

— vendors and implementors of systems with medication safety alerts or those who provide information for the alerts, such as:

  — CDSSs

  — EHRs

  — pharmacy systems

  — clinical information systems

  — practice management systems (EHR-like systems for individual or small-group settings).

Health informatics — Requirements for medication safety alerts

1 Scope

This document specifies the requirements for medication safety alert systems and the topics which are relevant to alert system vendors. This document applies to clinical decision support systems (CDSSs) whether or not these are medical devices.

This document addresses:

— requirements for terminology used in medication safety alerts;

— requirements for choosing a knowledge base for medication safety alert systems;

— requirements for the proper functionality of CDSSs as related to medication safety alert systems;

— requirements for medication safety alert display;

— requirements for quality measurements to improve the effectiveness of medication safety alerts.

The following are out of the scope of this document:

— the development of content (rule-based knowledge base) for CDSS;

— the development of algorithms for generating medication safety alerts in CDSS;

— the development of alert processors for medication safety alerts in CDSS.

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/TS 22756, *Health informatics — Requirements for a knowledge base for clinical decision support systems to be used in medication related processes*

ISO 27789, *Health informatics — Audit trails for electronic health records*

IEC 82304-1, *Health software — Part 1: General requirements for product safety*

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
administration
(self-) administering a (prescribed) medicinal product to the patient, using an administration method, and via a defined route, and recording that the act has actually happened at a particular date and time

[SOURCE: ISO/TS 19256:2016, 3.1]

3.2
clinical decision support
CDS
software system that assists healthcare providers in making medical decisions

Note 1 to entry: These types of systems typically require input of patient-specific clinical variables and as a result provide patient-specific recommendations.

[SOURCE: ISO/TR 14639-2:2014, 2.8, modified]

3.3
clinical decision support system
CDSS
software that is 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

Note 1 to entry: Patient-specific assessments or recommendations are then presented to the clinician or the patient to aid in the process of making evidence-based clinical decisions

[SOURCE: ISO/TS 22756:2020, 3.2, modified]

3.4
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]

3.5
dispenser
specialization of a healthcare professional which is a representation of an individual professionally responsible for filling/dispensing the prescription

Note 1 to entry: The dispenser is usually a pharmacist but can be other individuals according to local jurisdiction.

[SOURCE: ISO 21549-7:2016, 3.5, modified]

3.6
drug (pharmacy) and therapeutics committee
DTC
forum to bring together all stakeholders involved in decisions about drug use

Note 1 to entry: The described forum can exist at any level within the health-care system – at district level (overseeing primary health-care facilities), in hospitals, or at the national level.

[SOURCE: *Drug and Therapeutics Committee – A Practical Guide*. World Health Organization, 2003]

3.7
drug utilization review
DUR
authorized, structured, ongoing review of healthcare provider prescribing, pharmacist dispensing and patient use of medication

[SOURCE: Academy of Managed Care Pharmacy – Managed Care Glossary]

3.8
electronic health record
EHR
logical representation of information regarding or relevant to the health of a subject of care

[SOURCE: ISO/TS 13972:2015, 2.24]

3.9
formulary list
list of medicines approved for use in a specific health-care setting

[SOURCE: *Drug and Therapeutics Committee – A Practical Guide*. World Health Organization, 2003]

3.10
formulary system
principles, criteria, procedures and resources for developing, updating and promoting the formulary (essential medicines) list

[SOURCE: *Drug and Therapeutics Committee – A Practical Guide*. World Health Organization, 2003]

3.11
knowledge database
system in which knowledge on a specific topic is specified as a set of declarative statements, 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]

3.12
medication history
record keeping of the specificities of the prescribed/dispensed/OTC medicinal product (e.g. identification, brand, type, form, quantity, dosage)

Note 1 to entry: this record contains the medication still in use as well as the medication no longer in use.

[SOURCE: ISO/TS 19256:2016, 3.23, modified]

3.13
medication safety
freedom from preventable harm with medication use

[SOURCE: ISMP Canada, 2007, available at https://www.ismp-canada.org/definitions.htm#:~:text=Medication%20Safety%3A,did%20not%20reach%20the%20patient]

3.14
medication use evaluation
performance improvement method that focuses on evaluating and improving medication use processes with the goal of optimal patient outcomes

Note 1 to entry: medication use evaluation may be applied to a medication or therapeutic class, disease state or condition, a medication-use process (prescribing, preparing and dispensing, administering and monitoring) or specific outcomes.

[SOURCE: ASHP Guidelines on Medication-Use Evaluation, available at https://www.ashp.org/-/media/assets/pharmacy-informaticist/docs/sopit-formulary-guideline-medication-use-evalutation.ashx?la=en]

3.15
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

[SOURCE: ISO 11615:2017, 3.1.50, modified]

3.16
monograph
<medicinal products> written, unbiased evaluation of a specific medication

Note 1 to entry: Such a document includes the drug name, therapeutic class, pharmacology, indications for use, summary of clinical trials, pharmacokinetics/dynamics, adverse effects, drug interactions, dosage regimens and cost.

[SOURCE: ASHP Guidelines on the Pharmacy and Therapeutics Committee and the Formulary System, available at https://www.ashp.org/-/media/assets/policy-guidelines/docs/guidelines/gdl-pharmacy-therapeutics-committee-formulary-system.ashx]

3.17
overutilization
use of a drug in a quantity, strength or duration that is greater than necessary to achieve a desired therapeutic goal or that puts the recipient at risk of a clinically significant undesirable effect, or both

[SOURCE: US CFR 42§456.702, available at https://www.govinfo.gov/content/pkg/CFR-2011-title42-vol4/pdf/CFR-2011-title42-vol4-sec456-702.pdf]

3.18
pharmacy electronic health record
PEHR
logical representation of information regarding or relevant to the health of a subject of care in pharmacies in community or organized healthcare organizations

[SOURCE: Pharmacy Health Information Technology Collaborative HL7 EHR-System for a Pharmacist/Pharmacy Electronic Health Record Implementation Guide for Community Practice, available at https://www.hl7.org/documentcenter/public/standards/informative/13-294_HITSbook_HL7_Web.pdf]

3.19
predetermined standard
criteria and standard that has been established in accordance with the requirements of a drug use review programme

[SOURCE: US CFR 42§456.702, available at https://www.govinfo.gov/content/pkg/CFR-2011-title42-vol4/pdf/CFR-2011-title42-vol4-sec456-702.pdf]

3.20
prescribing
creating a prescription

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

3.21
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 should be 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]

3.22
screening
process of inspecting data for errors and correcting them prior to doing data analysis

Note 1 to entry: The screening can involve checking raw data, identifying outliers and dealing with missing data.

[SOURCE: Business Dictionary, WebFinance Inc.]

3.23
substance
matter of defined composition that has discrete existence, whose origin may be biological, mineral or chemical

[SOURCE: ISO 11238:2018, 3.84, modified]

3.24
underutilization
use of a drug by a beneficiary [recipient] in insufficient quantity, strength or duration to achieve a desired therapeutic goal or that puts the recipient at risk of a clinically significant undesired effect, or both

[SOURCE: US CFR 42§456.702, available at https://www.govinfo.gov/content/pkg/CFR-2011-title42-vol4/pdf/CFR-2011-title42-vol4-sec456-702.pdf]

4 Abbreviated terms

CPOE	computerized physician order entry
DDI	drug–drug interaction
IDMP	identification of medicinal products
MPD	medicinal product dictionary
ORCA	operational classification
PBM	pharmacy benefit manager

5 Requirements

5.1 General

This document applies to medication safety alerts which will be prospectively presented to healthcare providers at the point of care during medication use processes in clinical settings where a digitized health information system is operational to manage medication therapy for patient care.

The prospective safety alerts are displayed on visually verifiable devices before medication is prescribed, dispensed or administered to the patients, whereas the retrospective alerts occur after the patient has received the medication.

Since the ultimate goal of medication safety alerts is to prevent adverse drug reactions (ADRs) and ineffectiveness of the drug by minimizing or preventing medication and device error as depicted in Figure 1, this document focuses on drug use processes at any time before the prescribed medication is actually administered to the patient.

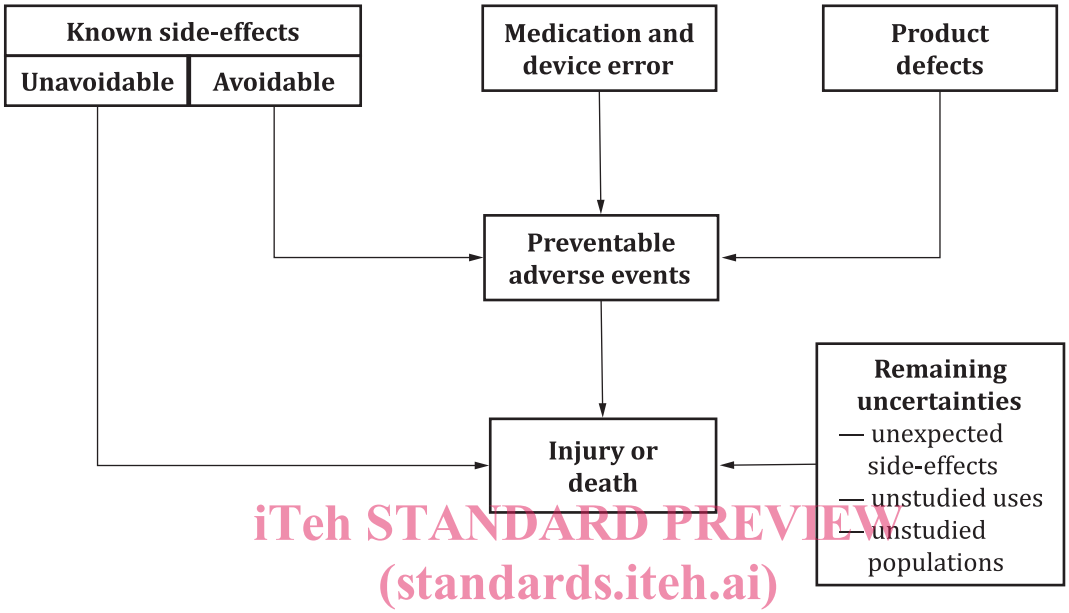

Figure 1 — Preventing ADRs[13]

A knowledge base can be the basis for detecting potential drug-related problems in a specific patient considering his or her clinical conditions (e.g. age, sex, concurrent medical diagnosis and medication, drug allergy history).

It is not within the scope of this document to create knowledge bases or gather patient clinical information. Rather, this document defines the requirements for selecting potential medication problem types for safety alerts based on the available knowledge, guides the method for how to find the conflicts between the predetermined thresholds (or standards) and prescription information (to be prescribed, dispensed or administered) based on specific patient clinical information and creates the signals to be alerted to healthcare providers in computerized health information system shown in Figure 2.

Although the rule-based knowledge base described in ISO/TS 22756 can contain a broader spectrum of rules for medication safety alerts than the scope of this document, this document focuses on the potential medication problem types which are more commonly selected in clinical settings to prevent or minimize drug-related problems and safety risks.

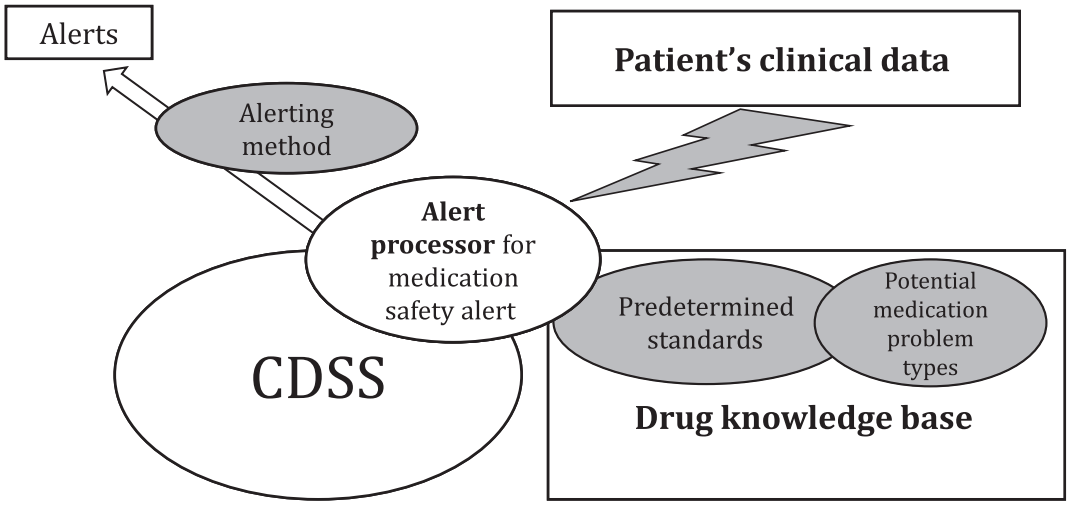

Figure 2 — Conceptual model for medication safety alert

5.2 Potential medication problem types for medication safety alerts

5.2.1 General

In principle, all potential safety risks of medication use fall into the scope of a medication safety alert system. However, the findings of potential safety risks for a specific patient can vary depending on the availability of data (e.g. patient clinical status, active problems, medication history, medication adverse event history), system capabilities (e.g. CDSS screening capabilities) and the information available in the associated drug knowledge base.

Ideally, the medication safety alert system should include as many of the potential problem types in this document as possible. However, the actual problem types implemented are determined by healthcare organizations in compliance with regional jurisdictions, pertinent regulations and guidelines for safe use of medication, while considering the available drug knowledge base and screening capability of the system.

5.2.2 Selection of potential medication problem types

There is no internationally agreed standard for selecting potential medication problem types for safety alerts. However, some national or regional jurisdictions have established requirements for medication safety alerts in the form of prospective and/or retrospective drug utilization review (DUR).

In the USA, the National Committee for Quality Assurance (NCQA), Centers for Medicare & Medicaid Services (CMS) and many other government agencies mandate that drug reviews be performed to ensure appropriate drug therapy. Specifically, the Omnibus Budget Reconciliation Act of 1990 (OBRA 90)[14] mandates that pharmacists conduct prospective and retrospective medication reviews whenever an outpatient prescription is dispensed to a Medicaid recipient. In US federal regulations, the following potential medication problem types for prospective DUR are specified for medication safety alerts when pharmacists are dispensing medication to patients in the community:

a) **Therapeutic duplication –** the prescribing and dispensing of two or more drugs from the same therapeutic class such that the combined daily dose puts the recipient at risk of an adverse medical result or incurs additional programme costs without additional therapeutic benefit.

b) **Drug–disease contraindication –** the potential for, or the occurrence of:

   1) an undesirable alteration of the therapeutic effect of a given drug because of the presence, in the patient for whom it is prescribed, of a disease condition; or