

Detecting, Monitoring, and Reporting Possible Adverse Drug Events Using an Arden-Syntax-based Rule Engine

Karsten Fehre^a, Manuela Plößnig^b, Jochen Schuler^c, Christina Hofer-Düchelmann^d,
Andrea Rappelsberger^e, Klaus-Peter Adlassnig^{a,e,*}

^a Medexter Healthcare GmbH, Vienna, Austria

^b Salzburg Research Forschungsgesellschaft mbH, Salzburg, Austria

^c Paracelsus Medical University Salzburg – Private Foundation, Salzburg, Austria

^d Landesapotheke am St. Johanns-Spital, Salzburg, Austria

^e Section for Medical Expert and Knowledge-Based Systems, CeMSIIS, Medical University of Vienna, Vienna, Austria

Abstract

The detection of adverse drug events (ADEs) is an important aspect of improving patient safety. The iMedication system employs predefined triggers associated with significant events in a patient's clinical data to automatically detect possible ADEs. We defined four clinically relevant conditions: hyperkalemia, hyponatremia, renal failure, and over-anticoagulation. These are some of the most relevant ADEs in internal medical and geriatric wards. For each patient, ADE risk scores for all four situations are calculated, compared against a threshold, and judged to be monitored, or reported. A ward-based cockpit view summarizes the results.

Keywords:

Adverse drug events; Arden Syntax rule engine; clinical decision support; drug monitoring; pharmacovigilance.

Introduction

The increasing use of medical drugs has raised the risk of drug-related damage, especially in elderly patients. Although a legal obligation to report adverse drug events (ADEs) has been instituted in several countries, the number of reported cases remains low. Only about 10–20% of medication errors and 1–13% of detected ADEs are reported. ADE detection and reporting is a time-consuming and expensive task. Hospitals need an efficient way to quantify the numbers and severity of ADEs before corrective action can be taken by pharmacists and physicians.

Methods

An ADE cockpit for detecting, monitoring, and reporting possible ADEs has been developed in the iMedication project [1]. The core of the software implementation is a decision support system employing a hybrid approach, combining the IHI Global Trigger Tool method and Morimoto's classification to detect suspected ADEs. The system's knowledge base consists of medical logic modules which encode medical expert knowledge in Arden Syntax [2], and the modules are executed by an Arden Syntax rule engine on a server. The data to be processed are derived from various sources—the hospital information system, an electronic health record, and entered information—and divided into six

categories: demographic data, laboratory test results, the patient's symptoms, diagnoses, medications, and hospital events. The aggregated information of a single patient is delivered to the Arden Syntax server, which returns a detailed interpretative summary for each identified ADE consisting of a) an ADE risk score which reflects the degree and severity of the ADE, b) the institutions to be informed, depending on the severity of the ADE, c) the triggers having fired, and d) the complete patient information used for interpretation.

Results

Four clinically relevant situations (hyperkalemia, hyponatremia, renal failure, and over-anticoagulation) were selected as exemplary conditions. The corresponding knowledge bases containing the respective ADE triggers together with their significance, expressed as scores between 1 and 3, were established in close collaboration between experienced clinicians and medical knowledge engineers. All four possible ADEs were analyzed for 100 patients. The test yielded a sensitivity of 88% (3 false negatives out of 25) and a specificity of 87.7% (46 false positives out of 375).

Conclusion

The proposed system is suitable for: (a) quality assurance by retrospective evaluation of clinical data in regard of suspected ADEs, (b) active feedback for clinicians during patient treatment, and (c) pharmacovigilance reporting.

References

- [1] Plößnig M, Schuler J, Hansbauer B, Stroka S, Engel T, Hofer-Düchelmann C, Radulescu M, Adlassnig KP. Semi-automated identification of potential adverse drug events. In: Schreier G, Hayn D, Hörbst A, Ammenwerth E, eds. Tagungsband der eHealth2012. Wien: OCG, 2012; pp. 51-6.
- [2] Samwald M, Fehre K, De Bruin J, Adlassnig KP. The Arden Syntax standard for clinical decision support: Experiences and directions. *J Biomed Inform* 2010; 45(4): 711-8.

* Correspondence to klaus-peter.adlassnig@meduniwien.ac.at.