



# Clinical rules and decision support systems for medication safety: the future is now

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## History

In the 'first generation' prescriptions were handwritten, collected by the patient and interpreted by a hospital pharmacist. The effectiveness depended on the knowledge of individual hospital pharmacists and the accuracy and availability of patient drug data.

A major step forward was the implementation of automated pharmacy systems in the eighties using the integrated Dutch drug database (G-standard). Prescriptions were entered into the system manually and basic drug safety alerting was supported by checking for drug–drug interactions, duplicate therapy, drug allergies and dosing (second generation). A drawback of these 'drug-oriented' systems was the absence of patient-specific clinical data, for example, kidney function. Furthermore, order entry often took place after the drug had been administered, so alerts were generated too late, 49–96 % of the alerts were overridden.

In the new century CPOE and electronic patient medical records (EMR) are increasingly being implemented by Dutch hospitals. Although CPOE and EMR are effective in reducing the inefficiencies and errors inherent in manual and paper-based processes, national studies, e.g. Nivel, HARM, show that medication safety still needs improvement. So in 2003, the Netherlands Association of Hospital Pharmacists (NVZA) started a medication safety campaign with the objective of structural knowledge sharing and working together. This has resulted in a blueprint for a medication safety management System (VMS) now used in all Dutch hospital pharmacies.

## The present

Many consider EMRs an outcome, but in fact they are only the starting point of a clinical decision support system (CDSS) revolution. CDSSs are designed to aid decision making by matching individual patient characteristics to a computerised clinical rule base to generate patient-specific recommendations.

In the last decade, research on the development, validation and implementation of clinical rules and CDSS expanded greatly and is now performed at numerous institutions.

Some initiatives:

- Dr P de Clercq at the Catharina Hospital Eindhoven in cooperation with the Technical University Eindhoven developed a CDSS (Gaston) as a PhD project. Since then research at the hospital pharmacy has focused on the multidisciplinary development, validation and implementation of clinical rules. The implementation of a set of 10 clinical rules in operational medication surveillance resulted in 2010 in approximately 4,000 alerts acted upon by physicians.
- At Leiden University Medical Center, as part of a PhD, a set of clinical rules was developed (adverse drug event alerting system; ADEAS) to be used in the Gaston CDSS. In a prospective study (six months, internal medicine ward), the hospital pharmacist made 14 (19.4%) interventions following a true positive alert with ADEAS and five (3.7%) with the conventional method.
- At the Maxima Medical Center Eindhoven, clinical rules have been developed by M van de Poll and implemented with good clinical results without using a specific CDSS.

- A 'national' clinical rule for clozapine treatment has been developed by a multidisciplinary working party of hospital pharmacists and psychiatrists.

Recognising the importance of this development the NVZA incorporated 'clinical rules' into the VMS and in 2008 initiated a working party to develop and coordinate a set of 'national' clinical rules. In 2011, this resulted in seven clinical rules on kidney function and dosing, gastro-protection, coumarins, opioids and laxatives, etc.; and a *Guide to the development, validation and implementation* (of clinical rules).

## The (near) future

Clinical rules and CDSSs represent the third generation of medicines monitoring systems. Widespread use in the near future seems warranted. This will overcome the drawbacks of second generation systems and support the role of hospital pharmacists. Impact and acceptance of the alerts generated will be improved by the (inter)national development of clinical rules in multidisciplinary teams. Drug databases (like the G-standard) will be restructured to accommodate the use of clinical rules.

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