Implementation of a computerized physician medication order entry system at the Academic Medical Centre in Amsterdam

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Key words
Computerized Physician Medication Order Entry
Electronic prescribing
Implementation
Medication errors
Medicator®

Abstract
In the period 1997–2001 the Academic Medical Centre in Amsterdam implemented the computerized physician medication order entry (CPmOE) system Medicator®. This article describes several important aspects of this program: technological architecture, features, implementation project, authentication and training, continuous support, human resource investments, route of prescription, logistics and administration. Furthermore important advantages and disadvantages of the CPmOE system are discussed. Advantages mainly concern patient safety and drug logistics, while disadvantages are related to access to a computer, user friendliness of the software and printer problems.

Accepted March 2003

Introduction
A computerized physician medication order entry system (CPmOE) is thought to be a useful tool for the reduction of medication errors and for the improvement of medication logistics. Therefore, the use of CPmOE systems in hospitals is growing, especially in the United States of America (USA). However, a survey showed that in 1999 only 5% of the hospitals in the USA were applying such a system. Several papers have been published on the implementation of a CPmOE system. Factors reported as important for success or failure are: technical features, user-friendliness, organisation of the implementation and cultural and behavioural patterns of hospital personnel. In the Academic Medical Centre (AMC), which is a 1050-bed teaching hospital, the implementation of the CPmOE system Medicator® was successfully completed in July 2001. Thereby the AMC was the first centre in the Netherlands using such a system hospitalwide. In this article we describe the implementation and maintenance of the system, its features and its (dis)advantages compared to conventional prescribing.

Conventional medication ordering
From clinical pharmacy practice it is well known that handwritten medication orders account for (potential) medication errors due to illegibility, the use of non-conclusive short-names, incompleteness, etc. These factors may contribute to logistical problems in the pharmacy department or on the ward, necessitating contacts between the pharmacist or the nursing staff and the prescribing physician, and leading to delay in drug administration to the patient. The ultimate result may be that the patient receives inadequate pharmacotherapy.

The CPmOE system Medicator® in the AMC
At the start of the implementation in 1997 only a character-based version of the program, named Medicatie® (Hiscom BV, Leiden, The Netherlands), was available. Currently, the AMC uses a Windows-based version of this program, called Medicator®, that was introduced in 2000.

Technological architecture
The CPmOE system consists of several components. A locally installed Windows client communicates with the central hospital information system and retrieves its data from several databases (Figure 2). Drug identification and medication control is performed based on the pharmacy drug database together with the national drug database (the Z-index of the Royal Dutch Association of Pharmacists (KNMP)), which contains data on overdose, interactions and (pseudo) double medication. This database is updated every month.

Features of Medicator®
A patient can be selected in two ways. By selecting a ward (pull-down menu) and then the patient, or by entering the patient’s name and either patient number or date of birth. Medication can be selected from the local stock (default) or the pharmacy drug database.

Standardized prescriptions (a single medication order with fixed dose, route, frequency, duration etc.) and medication protocols (several prescriptions belonging to one pharmacotherapeutic protocol) can be programmed. Standardized prescriptions and protocols can be linked to a ward and can be subdivided into groups (e.g., lung cancer) and subgroups (e.g., specific type of lung cancer). Within protocols a link to the relevant laboratory values can be programmed.

The system generates safety alerts concerning overdose, (pseudo) duplicate medication and drug–drug interactions, based on the data in the Z-index.

Links are programmed to relevant drug information sources such as the (paediatric) drug formulary, the antibiotic drug formulary, drug handbooks, acute care protocols, therapeutic drug monitoring protocols, Micromedex, PubMed, etc.

Implementation in the clinic
In 1995 a pilot project with Medicator® was started in three wards. Two years of testing, program adapta-
tions in cooperation with Hiscom and procedure improvements followed. In 1997 full implementation was started. This was done within an organization structure with a management team, a project team and a help desk. Medicator was subsequently introduced one-by-one on all wards except the coronary care unit, the adult intensive care unit, the children’s intensive care unit and the neonatology intensive care unit. In the last three units medication is electronically prescribed in the patient data management system (PDMS), a computer system in which all patient data are being managed. In July 2001, the implementation of Medicator® at 27 wards was completed. As the implementation was interrupted for one year due to a lack of personnel, overall implementation had taken three years.

Authentication and training
Only physicians have permission to enter prescriptions. They receive entrance to the system after receiving a training. Nurses receive permission to order refills of current medication. During the implementation of the character based version of the program, every new physician was trained individually for approximately one hour and nurses were trained in a group. After full implementation of the Windows version, a group training for new physicians was incorporated into the general introduction program of the hospital. In this training a application manager or pharmacist gives a presentation of the system to a class, using a beamer. Authentication (a check to make sure that only trained physicians receive entry permission) via the user-number is done by the pharmacy. By July 2001, about 800 physicians had been trained by the project team members. New nurses learn to work with the system from their colleagues.

Continuous support
Support of the system consists of a 24-hour helpdesk, the continuous training of new physicians and the maintenance and increase of the number of standard medication schedules and medication protocols.

Personnel needed for implementation and maintenance
For the implementation, the pharmacy consigned a full-time application manager, a full-time pharmaceutical technician, a full-time pharmacist and 0.1 full-