Development of an electronic prescription processing option: an aid for general practice

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SUMMARY. An interactive computer-supported prescription processing system has been developed as an add-on to existing general practitioner information systems. The aim of the system is to improve the clarity, efficiency and economy of drug treatment choices and prescription writing. It enables the doctor to choose the best treatment from the system's formulary according to the patient's complaint, symptom or diagnosis. The selections are based on complaints and diagnoses from the International classification of primary care *(ICPC). A prescription is printed and the potential exists for individualized patient instruction leaflets to be printed. Furthermore, the system may prove useful for retrospective and prospective statistical and epidemiological studies. This implies continuous adaptation, which is also necessary to keep the system updated. As well as an aid in daily general practice, the system is also designed to serve the needs of graduate and postgraduate training programmes.*

Introduction

THE decision by a doctor to write a prescription for drug treatment follows from a consideration of the patient's complaints, complemented where necessary by physical examination and laboratory tests. In between 55% and 95% of patient visits to the general practitioner's surgery the doctor concludes the visit and examination by writing a prescription.[1,2]

There are a wide variety of opinions as to what constitutes an effective prescription.[3,4] General practitioners choose not only different drugs but also a great variety of doses, dosing intervals and durations of treatment. It seems worthwhile — from the point of view of achieving quality at acceptable rates of cost and time required — to approach the writing of a preferred prescription by modern computer-supported methods.[5] Moreover, since errors in prescriptions are a subject of serious concern,[6-8] and 13–33% of all prescriptions are repeats,[9] computerization of prescribing may prove to be an accurate and efficient tool. This paper describes the development of a computerized prescription system for use in general practice: the electronic prescription processing option.

Description of the system

Technical description

The software has been developed at the Department of Clinical Pharmacy, University of Nijmegen, and has been written for IBM XT, AT and closely compatible personal computers including 386 machines, operating under MS-DOS versions 3.0 and upwards. The minimum memory required is 640 Kbytes random access memory (RAM). A hard disk with a capacity of at least 20 Mbytes or ideally 40 Mbytes is essential. Also required are a dot matrix printer and a general practitioner information system or patient management system which hold all the patient records.

The software has been designed as a 'terminate and stay resident' programme. This means that the programme stays in the memory (RAM) after installation. While a patient record is being edited, the prescription system can be activated in less than one second by a key sequence and it then runs synchronously with any general practitioner information system operating under MS-DOS.

Contents of the system

The system consists of two different programmes: Prescriptor and Preditor.

With Prescriptor the general practitioner performs a search on a large prescription database to choose, select and print a prescription. Additional information on contraindications, usage during pregnancy and lactation, drug interactions as well as warnings/precautions can be presented. Before the chosen prescription is printed, final checks are made on drug interactions and contraindications. For the most frequent drug interactions decision support is available to advise the doctor on possible actions, depending on the actual circumstances. Repeating a prescription is easily performed from the medication history screen. This screen also enables checks on patient compliance. Repeat prescribing of drugs which produce serious side effects or may lead to dependence can be blocked.

With the Preditor programme the general practitioner can edit and update the prescription database in a menu-driven way. The database is connected to a list of symptoms and diagnoses. Facilities are provided to control dosage and to check the minimum age of a patient at which a drug can be prescribed. Drug selection is supported in different ways, using the generic name code and trade product code registers of the drugs databank of the KNMP (Royal Dutch Association for the Advancement of Pharmacy). For example, for each generic name it is possible to generate an overview of pharmaceutically equivalent preparations with their distinctive brand names. The definition of doctors' own formulations is supported by the compound register of the drugs databank which lists basic ingredients. The composition of drugs can be displayed by pressing a function key.

Occasionally, the general practitioner will want to change the therapy choice or dosage at the patient level in Prescriptor in the same way as in Preditor, but the changes will be saved in the medication history and not in the prescription database.

Contents of the prescription database

The standard medication selections in the prescription system are based on several local formularies and expert opinions from the Central Medical Pharmaceutical Committee of the Ziekenfondsraad (Sickness-Benefit Council) published in the *Farmacotherapeutisch Kompas* [*Pharmacotherapeutical Compass*].[10] The user is able to adapt this formulary to local or regional preferences. The diagnoses are classified according to the

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International classification of primary care (ICPC).[11]

Currently the prescription database contains approximately 200 chemical entities. These represent 400 different preparations which are linked to 230 symptoms, complaints and diagnoses. That is 33% of all *ICPC* titles. The general practitioner can choose from about 1000 prescriptions.

Operation of Prescriptor

When writing a prescription the doctor activates Prescriptor and selects the patient from the civil status screen of the general practitioner information system. Then, the actual patient data, including age, are loaded or entered into the programme. After an entry has been typed in, the screen displays appropriate *ICPC* titles to select. As an alternative it is also possible to perform a therapy or product search in the prescription database without entering a specific indication. Another method of approaching the *ICPC* is pressing a function key. This results in an overview of *ICPC* chapters, after which the contents of a chapter can be shown. Figure 1 shows the chapter contents when 'Respiratory' is selected from the list of *ICPC* chapter headings.

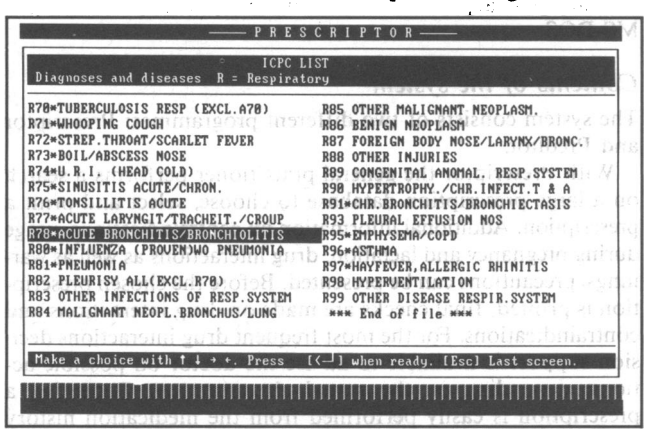

Figure 1. *Table of* ICPC *titles in the respiratory chapter (PC monitor screen).*

When the general practitioner selects the desired item, generally one therapy scheme with a choice of up to three drug therapies will be presented immediately (Figure 2). In some cases more therapy schemes are offered to cover the needs of general practice (Figure 3). Up to three prescriptions are 'hidden' behind every therapy, each varying in route of administration, in strength or in quantity. The next screen shows the dosage adjusted automatically to the age of the patient and the proprietary name prescription in full (Figure 4).

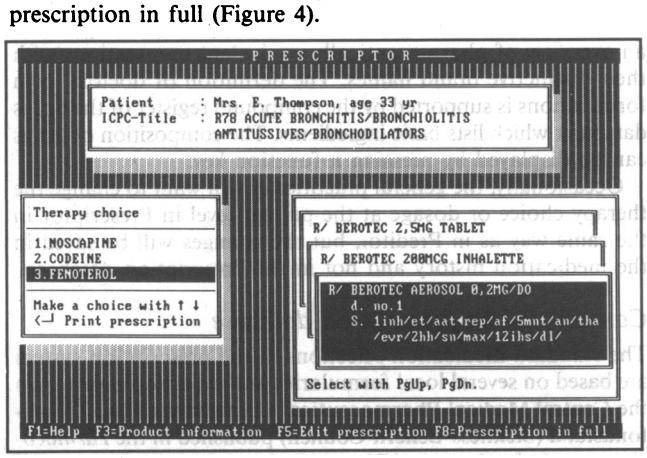

Figure 2. *Therapy scheme with linked therapy choices and prescriptions, generated by Prescriptor for this particular age category (PC monitor screen).*

Figure 3. *Second therapy scheme, containing antibiotic therapies (PC monitor screen).*

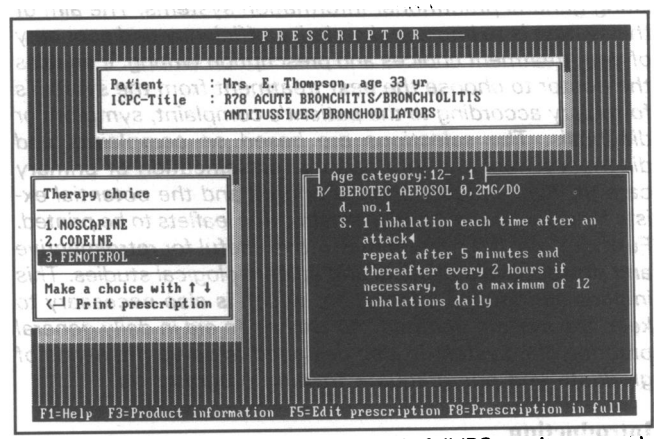

Figure 4. *Proprietary name prescriptionn in full (PC monitor screen).*

By selecting a prescription it is printed and stored in an individual medication history (Figure 5), provided that the control function did not detect any drug interactions or contraindications. The name, address and telephone number of the doctor and the patient are also printed, as well as the date of birth and the health insurance number of the latter. The authorizing signature of the general practitioner is the only missing element.[12] The patient receives a copy of the prescription to be handed to the pharmacy. After that, the general practitioner returns to the general practitioner information system for the next patient. In the meantime Prescriptor remains on standby in the memory.

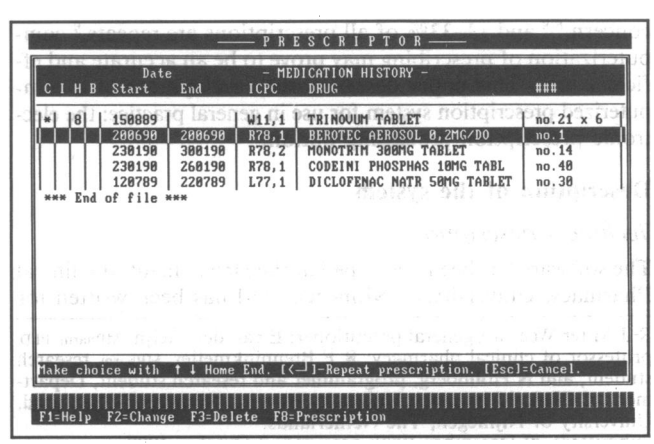

Figure 5. *Medication history of the selected patient (PC monitor screen).*

The description of the operation above reflects the usual procedure from selecting the *ICPC* title up to printing the desired prescription, without any delay caused by drug surveillance checks or editing changes. The contents of the prescription database will gradually reflect the doctor's preferences and experience, and the prescribing process will increasingly speed up. Then, the process of selecting a patient, entering a symptom or diagnosis, choosing a therapy, selecting a prescription and printing can be done in less than 20 seconds. If the general practitioner wants to change the therapy choice, quantity or dosage of a prescription, it will take 10 to 30 seconds longer.

In cases where possible drug interactions or contraindications arise the total processing takes more time, varying from 30 seconds if a warning only is given to two minutes if the drug surveillance also provides an advice procedure. But the latter must be seen as a worthwhile substitute for consulting a reference book or a pharmacist. When attention is called to a drug interaction the pharmacological or pharmacokinetic principles are highlighted. Depending on the circumstances the eventual advice focuses on the relevancy of the information, priority decisions and patient information on possible risks of simultaneous use.

Further developments

The most promising support for the selection of *ICPC* titles will be the authorized thesaurus, which contains a large synonym dictionary. A Dutch version of this thesaurus is being compiled at the department of general practice of the State University of Leiden. A pilot version is expected in spring 1991.

Our next step is to research and develop a method of producing individualized patient instruction texts based on standard information; these would be printed along with the prescription. Furthermore, a version of the system is available for use in a local area network in group practices and in institutions for elderly, handicapped, psychiatric or mentally retarded patients.

Finally, the development of an interactive training module for the pharmacotherapeutical principles of prescribing is being prepared in cooperation with the department of general practice and the medical computer education department of the University of Amsterdam.

Discussion

There is nothing new about using a computer for prescribing in general practice.[13-19] But Prescriptor is a far more powerful instrument than those described previously, partly because of the way that the drug therapies are linked to *ICPC* titles and partly as a result of the availability of advanced programming techniques. Any limitations the system has at the start are averted if the user is motivated to modify the knowledge database to fit his or her own experiences. The drugs databank guarantees maximum freedom of prescribing, whereas the programme design provides an integration of the standardization, choosing, processing, surveillance, archiving and readjustment of a prescription. That is more than a pen can do.

In the second half of 1988 a panel of six general practitioners and four pharmacists in the neighbourhood of Nijmegen tested a prototype in their own practices. At that time the database contained a limited number of drugs, referring to the top-50 complaints and diagnoses in general practice.[1] Without any further intervention the doctors succeeded in writing their prescriptions in 50% of cases. The quality of the prescriptions was especially welcomed by the ancillary staff of the pharmacies. One general practitioner reported that he had less discussion with his patients about the adequacy of drug treatments, because of his argument that the therapy of choice was 'proposed by the university'. Another doctor, a member of a group practice, reported a spontaneous renewal of consensus discussions with his partners which had not occurred for some years.

The goal of this feasibility study was to test the integrity of the software and to gain information about additional facilities and features which would be needed. The many remarks from the panel led to a considerably improved system. The next step is to start research into the wider application of the Prescriptor concept, such as the setting up of computer assisted formularies in local groups of general practitioners, with the aim of improving prescribing habits and reducing costs.

The database now contains an extended prescription formulary. It has been pointed out that an agreed local formulary is able to provide adequate and appropriate treatment for 90% of general practice patients.[20] The Preditor programme is a suitable tool with which to develop and update such a list. We suggest that it should be compiled by general practitioners and pharmacists. Many formularies are based on two different lines of approach: the problem oriented and the product oriented view. Preditor forges these two views into one therapeutic structure. Metaphorically, this structure can be understood as a chess-board (problems) with chess-pieces (products). The two disciplines dealing with pharmacotherapy — medicine and pharmacy — embody these two approaches. When representatives of both observe certain rules, a discussion concerning different positions on the chess-board can start from a clear perspective. Using a common framework for joint meetings together with centralized downloading procedures allows for regular review and assessment of policy.[21] The educational challenge of such a process is obvious. Therefore Prescriptor is also likely to be useful in the continuing education of general practitioners.

It has been stated that general practitioners' attitudes towards rationalization of prescribing are highly responsible and constructive.[22] Despite that, the results of follow-up studies after interventions to improve prescribing habits are not always encouraging.[23] The introduction of computer-supported methods could provide a powerful influence to bring about continuous intervention and more lasting changes. They may lead to an improvement in quality and a reduction in prescribing costs.[24,25]

The benefit of computerization for monitoring prescribing is clear.[26,27] Monitoring contributes considerably towards good general practice prescribing.[28,29] With Prescriptor, analyses of prescribing patterns are easily performed by anonymous downloading procedures.

Computerization of prescribing also offers exciting prospects for drug research in general practice. At a rough estimate more than 70% of all drugs are prescribed by the general practitioner. Nevertheless, 95% of drug evaluation is performed in clinical settings, despite the fact that the patient population is different from the one which is seen by the general practitioner for the same indications.[30] Postmarketing surveillance and prescription event monitoring especially are crucial in estimating the effects and safety of a new drug.[31] It has been emphasized that a satisfactory system is required which is both rapid and unselective.[32] Postmarketing surveillance and prescription event monitoring databases can provide essential information for epidemiological research.[33] They support the study of the use of medicines in relation to disease patterns, as well as the event monitoring of both the beneficial and adverse outcomes of treatment. One reliability study showed how accurate data could be collected, but also stressed the need for standardization of morbidity data.[34] The *ICPC*, implemented in Prescriptor, provides such a classification.

As stated earlier, we also intend the development of individualized patient instruction texts to be printed along with the prescription. The Patients' Liaison Group of the Royal Col-

lege of General Practitioners has already outlined some patient concerns about written information.[35] Patients want information sheets to be written in clear, unambiguous language. They wish leaflets which are easier to comprehend and which give information about ingredients, major and minor side effects, symptoms to report to the doctor, restrictions and manufacturer's names.

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