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Synopsis

Computer-Based Patient Records

The paper record is still the traditional means of recording patient data. Over the past decades, advances in computer technology and increasing complexity of health care have led to more awareness of the shortcomings of paper records [1-3]. Four well-recognized shortcomings are: (1) limited availability: as the paper record is a physical object, it can only be at one location at a time; (2) limited legibility, which is inherent to handwriting; (3) missing data, which raises the question whether information was lost, not considered relevant to record, or never assessed; and (4) poor access to and limited suitability of data for formal analysis and interpretation: data is difficult to retrieve, usually recorded in a non-standard format, and has to be interpreted and coded by hand.

The potential of computer technology to overcome these shortcomings has greatly encouraged interest in the computerization of patient data. The first two shortcomings - limited availability and legibility - can be eliminated simply by storing text electronically. To overcome the last two shortcomings, data will need to be represented in a structured, unambiguous format.

Research in the field of Computer-Based Patient Records (CBPRs) has produced a variety of systems. They range in functionality from transcribing encounter-forms by clerical personnel to data entry by physicians, and produce records with varying degrees of structure and coding [3]. Although the Institute of Medicine has recently encouraged the implementation and use of CBPRs [1], acceptance in medical practice is slow, especially for systems that are designed for use by physicians themselves. The four papers in this section address an interesting spectrum of issues, which are all relevant to the development, acceptance, and evaluation of CBPRs.

Rector et al. conducted important work on formulating foundations for CBPRs [4]. They state that a CBPR should be faithful, permanent, and structured. Based on these foundations, Rector proposes a framework for modelling the CBPR [5]. One of the philosophies behind the model is that observations, having been made, cannot change, whereas inferences based on them can. Hence, the model has separated the representation of direct observations on the patient, from the use of these observations in decision making. As to observations, Rector emphasizes that the patient record does not reflect what actually occurred, but reflects how various observers perceived the actual events. The "truth" can only be inferred from what has been recorded. The possible presence of multiple observations per object is a fundamental property of patient data, which has consequences for the design of a CBPR model. Whereas most object-oriented systems have only two abstractions - classes and instances - Rector introduces three. In his model, "categories" correspond with classes, "individuals" with instances, and "occurrences" with observations of instances at a particular point in time and space. The model yields certain advantages for retrieval of patient data: All patient cases of a certain condition, e.g., "fracture of femur", are represented by all individuals of the corresponding category. For a single patient, all occurrences of the individual "fracture of femur" represent all observations on that condition.

Although it is attractive to make patient data suitable and accessible for a variety of purposes, the main purpose of the CBPR is to document and consult patient information. Rector states that a CBPR must be intuitive and useful if it is ever to be accepted by physicians. Nygren emphasizes that the use of a CBPR must not interfere with the process of care and if possible must benefit that process with extra properties. To gain insight into the tasks that a CBPR should support, Nygren performed a thorough analysis of the uses of Paper Medical Records (PMRs) in relation to various clinical situations [6]. He identified that physicians consult records to achieve one or more of the following four main goals: (1) obtain an overview of a patient; (2) recall the clinical picture of a known patient; (3) search for a specific fact; and (4) problem solving. While consulting a PMR the physician may skip, skim over, or actually read (sections of) pages. Which reading type dominates depends on the goal involved, and on the degree to which the PMR supports the physician in finding the proper "search space". In other words: how easy is it to locate the sections, relevant to the clinical goal. Important in this respect are the order, structure, and appearance of documents. For example, when searching for results of lab tests, gray X-ray forms may be skipped. Or, when a progress note is long, something unexpected may have occurred, etc.

Which documents the physician will include in his search space varies with the goal. Discharge letters are found to be useful in obtaining an overview of the patient. The search space proves to be least predictable and most difficult to determine in the case of problem solving.

Based on his analysis, Nygren makes recommendations for the design of CBPRs. Physicians should be confronted with much information at a time, which they can easily digest by means of positional and textual structure. Document types should be easy to locate and browsing through the information forward and backward in time should be well supported. At all times, it must be obvious what information is contained in the record: there should be no concealed levels. In a subsequent paper, Nygren presents the design and implementation of a user-interface, based on the insights gained [7].

Apart from the creation of CBPRs that meet criteria for faithfulness and ease of use, the technology has to be introduced into the physician's daily practice. Van der Lei describes which factors facilitated the introduction of CBPRs into the daily practice of General Practitioners (GPs) in the Netherlands [8]. Between 1983 and the middle of 1992, the number of GPs using an information system rose from 1 to approximately 3,720 (58%). About 26% of these GPs have fully replaced their conventional paper records with a CBPR.

Professional organizations played a crucial role in the introduction of CBPRs. Dutch professional associations of GPs recognized the potential benefits of CBPRs and established a task force to formulate criteria which such systems should meet. They also took on the task to evaluate systems that vendors submitted to them. These initiatives saved GPs the trouble of deciding which systems would provide them with proper functionality. Besides ongoing revision of criteria and evaluation of systems, the expectations of potential users need to be realistic. Courses to train GPs on the use of a computer in their practice helped them in weighing the pros and cons, and in planning a possible introduction. Finally, since 1991, the Dutch Government stimulated the use of computers in general practice by offering financial support.

One of the pioneer systems is Elias. Elias consists of five modules, which allows gradual introduction of the system. One of these modules is the CBPR. Elias offers a set of extra options besides support of efficient record keeping for daily routine. The degree to which the GP can benefit from these options partially depends on the degree to which the physician codes his data. Special benefits include monitoring for screening and follow-up, access to practice guidelines, drug advice, and electronic communication with colleagues, pharmacies, laboratories, and hospitals.

As compared to the United States, where the use of CBPRs is still very limited, the Dutch situation is relatively successful. However, it should be kept in mind that the record as kept by a Dutch GP is quite different from that maintained by a specialist. In general, GPs make very short notes and the record is far less complex. Therefore, navigation through a GP record is simpler than through most specialists' records. Nygren's study involved a hospital setting and his recommendations apply to that setting. Although meeting the consultation needs of GPs was a great challenge, meeting those of specialists is an even greater one.

The benefit of CBPRs in primary care has not yet been formally evaluated although the rapid increase in their use indicates at least that such benefit is perceived. Tierney evaluated financial effects of computerized in-patient order-writing [9]. The main result was that in-patient charges dropped 12.7%. The strategy, used to achieve this result, involved several facets. At the time of making the orders, the physicians were supported in the selection of tests through problem-oriented menus, were informed about costs, and about possible contra-indications and interactions of ordered drugs. Although these results are promising, Tierney stresses that the introduction of systems for order-writing must be preceded by a careful trade-off of the cost of such a system, the benefit, and the acceptability to the users. The balance of these three aspects depends on the design. When acceptability receives too much weight, hospitals may be tempted to support physicians in ordering whole sets of tests at once. Such an interface may be highly acceptable from the user's point of view, but is likely to be cost-increasing.

The four papers in this section show that some tasks can be successfully supported electronically in some settings. It is not difficult to understand the potential benefit of CBPRs, but the more complex the physician's task, the greater the challenge to make a CBPR that is practical in use. The research presented and its continuation is crucial to gain further understanding of issues that are important for the design, introduction and evaluation of CBPRs. Human-computer interfaces currently form a field of high interest and its results should be interpreted and transferred to the medical setting. In addition to ongoing research to improve CBPRs, professional groups and organizations should support these efforts by active participation in the dissemination of and education on CBPRs.

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