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AN AID FOR THE OUTPATIENT MANAGEMENT OF CANCER PATIENTS

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Abstract

ONCOCIN is an oncology protocol management consultant that is designed to assist physicians in the treatment of cancer outpatients. The system is actually a set of programs, one of which is a rule-based Reasoner that encompasses the necessary knowledge of cancer chemotherapy. Of particular interest is the need to provide this reasoning system with a high speed interface to help make the system acceptable to oncologists. Other issues include the system's interaction with a large database of patient information and the need to design and execute formal evaluations of its impact in the clinical setting.

Introduction

ONCOCIN is an interdisciplinary research program involving physicians and computer scientists at Stanford University. The program is a computer-based consultation system designed to help oncologists manage outpatients on experimental cancer chemotherapy protocols. This problem was selected because of a clear clinical need for assistance in keeping track of the numerous complex protocols used to treat cancer patients in a busy university-based oncology clinic, and because of a conviction that the task is precisely the kind of clinical problem with which state-of-the-art computing techniques can effectively assist. Unlike conventional diagnostic problems in which the complexity of expert knowledge and reasoning has tended to prevent the development of clinically useful computer-based consultation tools, decision making in the oncology clinic has several distinctive aspects:

- (1) the techniques for managing patients are largely defined in structural protocol documents that attempt to anticipate complicating situations that may arise during the course of treatment;
- (2) oncology faculty and fellows frequently cannot remember the details of a protocol and therefore often spend time trying to find the answer to a question in a written document, calling the expert oncologist in charge of that protocol, or "making do" according to their best recollection of how to handle the unusual situation;
- (3) the quality of protocol-based research and its underlying statistical analyses is totally dependent upon accurate and compulsive completion of a flow sheet that summarizes

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the patient's response to therapy over time; and

- (4) similarly, the completeness of data collection for a protocol is dependent upon the patient's physician remembering to order all laboratory and radiologic examinations required by the study.

Since much of cancer chemotherapy research today is dependent upon rigorously designed and executed studies of alternate forms of therapy, a computer-based system that could assist with both management and data collection would provide significant benefits. ONCOCIN is designed to meet these needs. After two years of developmental work, a prototype was introduced in the Stanford Oncology Clinic in July 1981. The system currently deals with Hodgkins and non-Hodgkins lymphomas, and the encoding of additional protocols is planned for the coming months.

System Architecture

The current ONCOCIN prototype uses a customized video display terminal installed in the oncology clinic. The terminal has a routine character-oriented display, but we have modified the keyboard so that a physician can enter flow sheet information using only a 21-key pad to the side of the conventional keys. No typing is required. The terminal is driven at a speed that gives the appearance of nearly instantaneous filling of the screen.

After examining a patient, the physician interacts with ONCOCIN's data acquisition program, known as the Interviewer, and reviews data from the patient's previous visits to the clinic. The screen display is designed to look like the flow sheets that have traditionally been used for recording patient data. The physician uses the terminal keypad to enter information regarding the current visit; this interaction replaces the usual process of filling out the flowsheet by hand. As the physician enters data, the Interviewer passes the information to second program running in parallel, known as the Reasoner¹. This second process is a rule-based program that uses artificial intelligence techniques to determine optimal therapy for the patient based upon its knowledge of the protocol and the information that the physician is entering on the flowsheet. By the time the physician reaches the part of the flowsheet where he would normally have filled in the therapy plan for that day, the Reasoner has generated a therapy plan which it has passed back to the Interviewer for inclusion in the flowsheet. Thus the therapy required by the protocol is already filled in for the physician. Both the Reasoner and the Interviewer also use a shared database of prior patient information. Before

terminating the session, physicians may examine the explanation provided with each recommendation. They may approve or modify ONCOCIN's advice, and any changes are noted by the system and kept available for future review.

Knowledge Representation

Knowledge about the oncology domain is represented in the Reasoner using four main types of data structure: contexts, parameters, rules, and control blocks. Parameters and rules are similar to those used in our earlier work on the MYCIN System². However, contextual information and control knowledge is encoded separately from ONCOCIN's rules to achieve improved clarity when the system's reasoning is examined by a physician or system builder¹. As in MYCIN, rules are represented in a stylized format so that they may be translated from computer code into English for purposes of explanation. This representation scheme has also facilitated the development of programs to check for consistency and completeness of the rules in the knowledge base³. Below is an English translation of one of ONCOCIN's 260 rules:

RULE075

To determine the current attenuated dose for all drugs in MOPP or for all drugs in PAVe:

If: 1) This is the start of the first cycle after a cycle was aborted, and
2) The blood counts do not warrant dose attenuation

Then: Conclude that the current attenuated dose is 75 percent of the previous dose.

Evaluation Plans

Evaluation is critical to complement the implementation of ONCOCIN and to assess both its impact and the advisability of encouraging its wider dissemination. Three parallel studies have been designed and are now underway: (1) an opinion study to assess the effect of ONCOCIN on the oncologists' attitudes regarding both medical computing in general and ONCOCIN in particular; (2) a data collection study to compare the completeness and correctness of patient data collected using ONCOCIN with data collected prior to ONCOCIN when the clinic physicians used conventional paper and pencil techniques; and (3) an appropriateness of care study to evaluate the appropriateness of ONCOCIN's management advice, both in absolute terms and when compared to the decisions made by oncologists prior to the system's introduction.

Other Plans For The Future

In addition to the evaluation plans outlined above, our group has several goals for the future. First, we intend to encode and implement for use by ONCOCIN the other commonly used chemotherapy protocols from our oncology clinic. Second, we intend to transfer ONCOCIN from its current configuration on a DEC 2020 to personal workstations that can be dedicated for stand-alone use in the clinic. We thereby hope to extend ONCOCIN's role so that the system will eventually be used routinely for the management of all protocol patients.

Acknowledgments

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