

Report 84-22

Stanford - KSL

Scientific DataLink

Studies to Evaluate the ONCOCIN System.

Miriam B. Bischoff, Robert W. Carlson,

David H. Hickam, Charlotte D. Jacobs,

D.L. Kent, M.M. Koretz, et al., 1984

card 1 of 1

Heuristic Programming Project  
Report No. HPP 84-22

February 1984

# **Studies to Evaluate the ONCOCIN System**

**(Abstracts)**

**The ONCOCIN Project  
Heuristic Programming Project  
Departments of Medicine and Computer Science  
Stanford University  
June 1984**

The ONCOCIN Project is supported by research grants from the National Library of Medicine, the Division of Research Resources of the NIH, the Office of Naval Research, and the Henry J. Kaiser Family Foundation.

**CLINICAL INTEGRATION TO PROMOTE USE  
AND ACCEPTANCE OF A COMPUTER-BASED  
CONSULTANT**

**EH Shortliffe, MB Bischoff, RW Carlson, and CD Jacobs**

**Presented at Annual Meeting Society for  
Medical Decision Making**

**Toronto, Ontario**

**October, 1983**

One of the goals of medical decision making research is to devise methods for bringing practical assistance to physicians in the clinical setting. Computer programs to provide decision support have often been met with resistance by their intended users, even when their advice can be shown to be excellent. We accordingly describe the design and implementation of ONCOCIN, a consultation system that uses artificial intelligence techniques to encode the knowledge of lymphoma chemotherapy protocols as well as the expertise of lymphoma experts. It has been used regularly by oncology clinic physicians since May 1981. Of interest are the characteristics of the system, and of the domain, that have enhanced the system's acceptance by its users. These include its careful integration into routine clinic operations, with an emphasis on maintaining familiarity, minimizing training time, assuring ready access to a high-speed terminal, and replacing previous tasks rather than requiring an additive time commitment by the providers. The generation of hard copy reports that are useful to the physicians, and that were not previously available, has also been an important inducement to system use. Of particular note is the system's respect for the physicians' time (a session for data entry and consultation requires approximately five minutes) and experience (the system offers explanations for all recommendations and allows the user to override the program's advice). Although the system provides a useful model for the design of a decision aid to support clinical trials, it remains to be shown whether the program's success could be duplicated in a domain where physicians are less inclined to follow external guidelines.

**AN EVALUATION OF THE TREATMENT RECOMMENDATIONS  
OF A COMPUTER-BASED CANCER CHEMOTHERAPY  
PROTOCOL ADVISOR**

**DH Hickam, EH Shortliffe, and CD Jacobs**

**Presented at Annual Meeting Society for Medical  
Decision Making**

**Toronto, 1983**

With the increasing complexity of contemporary cancer chemotherapy treatment programs, it has become difficult to assure that chemotherapy protocols are followed accurately. Evolving clinical computing techniques offer the potential for improving protocol adherence. However, technologic innovations require rigorous validation before they are introduced for routine clinical use. We describe an evaluation of ONCOCIN, a protocol management advisor implemented at Stanford Medical Center for experimental use by physicians managing lymphoma patients. The program combines formal protocol guidelines with the experience of lymphoma experts who can adapt the protocols to aberrant situations.

We compared the therapy administered by oncology fellows with the treatment plan that would have been recommended by ONCOCIN in 415 pre-ONCOCIN clinic visits for 39 patients. In 189 visits the computer agreed with the therapy administered. The remaining visits were reviewed by four lymphoma therapy experts who were asked to assess the adequacy of a proposed treatment without knowing whether the plan was that of a fellow or of ONCOCIN. There was no significant difference between the experts' assessment of ONCOCIN and the fellows in the cases studied ( $p=.5$ ). Subanalyses showed the ONCOCIN tended to attenuate drug doses excessively, whereas the fellows more often failed to attenuate doses adequately. The fellows also failed to escalate drug doses approximately more frequently than ONCOCIN did. Analyses of this kind have assisted in validation of ONCOCIN and have also identified areas for physician education and for reassessment of current protocol guidelines.

# **A BLINDED EVALUATION of COMPUTER-BASED CANCER CHEMOTHERAPY TREATMENT ADVICE**

**DH Hickam, EH Shortliffe, and CD Jacobs**

**Submitted to Annual Meeting  
American Federation for Clinical Research**

**Washington, D.C.**

**April, 1983**

Rapidly evolving clinical computing techniques offer potential assistance with improved adherence to the treatment guidelines in cancer chemotherapy protocols. However, technologic innovations require rigorous validation before they are introduced for clinical use. We describe an evaluation of the ONCOCIN system, a novel protocol management advisor implemented at Stanford Medical Center for experimental use in the management of lymphoma patients. The program combines formal protocol guidelines with the experience of lymphoma experts who can adapt the protocols to aberrant situations.

417 pre-ONCOCIN chemotherapy clinic visits for 39 patients were selected to allow a comparison of the actual therapy administered by oncology fellows with the treatment plan that would have been recommended by the computer system. In 189 visits the computer agreed with the therapy administered. The remaining visits were reviewed by four lymphoma therapy experts who were asked to indicate the adequacy of a proposed treatment without knowing whether the plan was that of a fellow or of ONCOCIN. The program's performance was judged equal to that of the physicians. Its therapy was acceptable in 76.5% of cases, as compared to 76.0% of the physicians' cases ( $p=N.S>$ ). ONCOCIN tended to attenuate drug doses excessively, whereas the fellows often gave larger doses than were recommended by the experts. Analyses of this kind have assisted in validation of the computer system and have also helped identify areas for physician education and for reassessment of current protocol guidelines.

# **THE IMPACT ON QUALITY OF DATA MANAGEMENT OF A COMPUTER-BASED CONSULTANT PROGRAM**

**DL Kent, EH Shortliffe, MB Bischoff, and CD Jacobs**

**Presented at Annual Meeting Society for Medical Decision  
Making**

**Toronto, Ontario**

**October, 1983**

ONCOCIN provides expert management advice for patients enrolled in cancer chemotherapy protocols for lymphoma at Stanford. The system interacts with the oncologist: data are entered and advice given about drug therapy and required tests. Because valid clinical trials and optimal patient care require complete and accurate recording of patient data, we studied the impact of ONCOCIN on the quality of such data.

We reviewed hospital records and clinic flowsheets for Hodgkin's patients seen 10 months before (66 visits) and for 7 months after (56 visits) the program's implementation. Although ONCOCIN permits skipping of data entry tasks by the physician, there was improvement in the frequency of recording of expected data on clinic flowsheets. Percentage of physical findings recorded increased from 73% to 91% (p .05), toxicity history from 0% to 45% (p .0001), global MD judgements from 32% to 73% (p .0001), and xray results from 44% to 73% (p .005). Blood count recording was nearly perfect (99%) throughout the study. Analyses of visits recorded by a data manager when the computer was inaccessible to physicians showed no improvement in data recording. These results include statistical control for complexity of protocols and the experience of physicians at each visit. The system achieved improvement by encouraging recording of available data and by reminding the physician to order tests that might be forgotten.

We conclude that a clinical consultant program which includes data management services can improve the quality of protocol data and may thereby improve both clinical decisions and the analysis of accumulated patient data for clinical studies. The computer system's ability to interact with the physician is a vital part of its contribution to data quality.

# EVALUATION OF COMPUTER-BASED INTERACTIVE DATA MANAGEMENT FOR CLINICAL TRIALS

DL Kent, RW Carlson, CD Jacobs, and EH Shortliffe

Presented at the Annual Meeting of the Western Section  
American Federation for Clinical Research

Carmel, California

February, 1984

Complete and accurate data are the cornerstone of good clinical research and patient care. We analyzed sources of data loss before and after introduction of ONCOCIN, a computer-based assistant for management of cancer chemotherapy. Physicians use the system during a patient visit to record patient data and to receive advice about treatment and future tests required by protocol.

We studied flowsheets for 66 pre-ONCOCIN and 56 post-ONCOCIN patient visits, cross-checking entries with progress notes, x-ray files, and laboratory logs. Only data expected by the patient's protocol were analyzed. We noted how often tests were ordered, how frequently they were completed and how often the results were recorded. The results in the following table are expressed as percentages of the expected data.

Data Type	Recorder	Pre/Post	Ordered	Completed	Recorded
GENERAL	DATA	pre	50	47	36
CHEMISTRY	MANAGER	post	86	82	82 p<.01
X-RAY		pre	79	78	44
RESULTS	M.D.	post	89	89	73 p<.05
CLINICAL		pre	na	73+	73
OBSERVATIONS	M.D.	post	na	91+	91 p<.05

We conclude that ONCOCIN significantly enhanced the completeness of data collected, but that M.D. failure to obtain or order the information remained a major source of data loss. Accordingly, we believe that computers can improve the collection of clinical trial data if they can interact with and support the physician at the beginning of the data collection chain.

# PHYSICIAN ATTITUDES TOWARD A COMPUTER-BASED EXPERT ONCOLOGY CONSULTING SYSTEM

RW Carlson, EH Shortliffe, CD Jacobs, MM Koretz

Presented at Annual Meeting American Society for  
Clinical Oncology

Toronto, Ontario

May, 1984

ONCOCIN is an experimental, expert oncology computer consultation system which collects protocol data and makes treatment recommendations using artificial intelligence techniques. ONCOCIN has been in use at Stanford by oncology fellows administering protocol chemotherapy for lymphoma patients since May, 1981. We have previously shown that protocol data collection is significantly enhanced by physician use of ONCOCIN and that ONCOCIN provides treatment recommendations rated blindly by experts as equivalent to those actually delivered by Stanford oncology fellows.

Prior to, 1 year after, and 2 years after the introduction of ONCOCIN, a questionnaire and structured interview were administered to the oncology fellows to determine ONCOCIN's effect on computer knowledge and attitudes toward computer-based consultation systems. Individual responses were scored on an ordinal scale, and an analysis of variance was performed on composite scores. The results are:

	Baseline (N=7)	Year 1 (N=8)	Year 2 (N=12)	P-value
Computer Knowledge	-0.44	-0.29	-0.15	.39
Demands on Computer	0.22	0.37	0.47	.20
Expectations:				
Medical Computers	0.24	0.14	0.34	.20
Actual ONCOCIN	NA	0.04*	0.29	.07
Optimal ONCOCIN	0.52	0.55	0.80	.02

(-1=no knowledge or very negative, +1=extensive knowledge or very positive; \*N=9)

Our data suggest that physician attitudes toward medical computers are generally favorable. Use of an appropriately designed consultation system did not improve knowledge or demands of computers. However, it did increase expectations of the system used and enhanced already favorable attitudes.

**THE EFFECT OF ENHANCING CANCER CHEMOTHERAPY  
PROTOCOL GUIDELINES WITH EXPERT KNOWLEDGE IN A  
COMPUTER-BASED TREATMENT CONSULTANT**

**D.H. Hickam, E.H. Shortliffe, M.B. Bischoff, C.D. Jacobs**

**Submitted to Annual Meeting Society for Medical Decision Making**

**Bethesda, Maryland**

**November 1984**

Written protocols are widely used to guide treatment decisions for patients receiving multi-drug cancer chemotherapy. However, even the best-written protocols are ambiguous for certain clinical situations. A protocol advice system that supplements treatment algorithms with judgmental knowledge acquired from experts has potential for improving upon written protocols. We studied the therapy recommendations of ONCOCIN, a rule-based system that uses both algorithmic and expert knowledge to provide treatment advice for lymphoma patients. In 132 clinic visits for 38 patients treated by oncology fellows before the introduction of ONCOCIN, we determined the treatment recommendation that would have been provided by the computer and the treatment plan that would have been derived from strict application of the written protocol. All treatments were blindly reviewed for adequacy by four lymphoma therapy experts.

Of 105 visits for patients being treated on a single chemotherapy combination, ONCOCIN's treatment was judged acceptable in 69% of visits compared to 58% for the written protocol ( $P < 0.05$ ). The physicians' treatments were judged acceptable in 67%. In the 27 visits for patients whose treatment alternated between two combination chemotherapies, we could not demonstrate a significant difference between the rates of acceptable treatment by the three sources.

Our results suggest that a computer-based treatment advisor that supplements protocol guidelines with expert knowledge can provide advice that is in keeping with protocol intentions while avoiding rote application of the protocol algorithm in aberrant clinical situations.

FILMED FROM BEST AVAILABLE COPY

**Copyright © 1985 by KSL and  
Comtex Scientific Corporation**