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ONCOCIN: A CANCER PROTOCOL CONSULTANT

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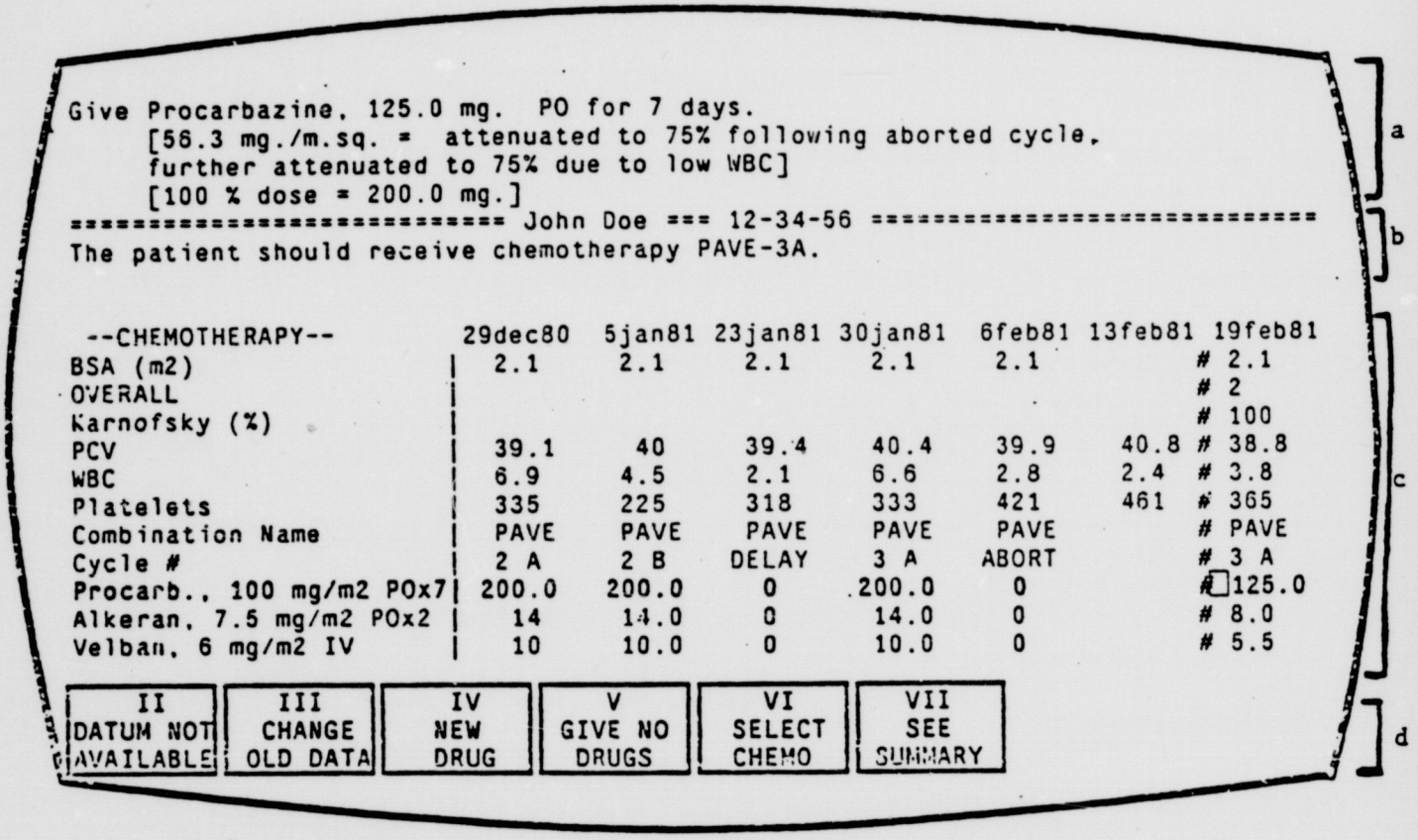
SYSTEM DESCRIPTION

ONCOCIN is an interactive oncology chemotherapy consultation system that assists physicians with the management of patients being treated on protocol. The system, which is in use at the Stanford Oncology Day Care Center, recommends chemotherapy dose selection and attenuation for a given patient using its knowledge about the protocol in which the patient is enrolled, plus stored data from the patient's previous visits. It also provides reminders, at appropriate intervals, of follow-up tests and films required by the protocol.

The system incorporates a special terminal interface to ensure that busy clinicians find ONCOCIN fast and easy to use (as well as simple to learn). The physician interacts with a high-speed video display terminal with multiple windows, simulating the appearance of the conventional paper flowsheet that is used in the clinic chart to record all the data required for adequate protocol analysis (see Fig. 1). A customized keyboard allows the physician to enter flow sheet information using only a 21-key pad to the side of the conventional keys; almost no typing is required.

Figure 1. Sample ONCOCIN Screen



This diagram shows the layout of a typical display seen by the physician when he uses ONCOCIN. The screen is divided into four sections as indicated.

a: the explanation field, which presents the justification for the recommendation indicated by the user-controlled cursor location (the box in the figure).

b: the message field, which identifies the patient and provides a region for sending pertinent messages from ONCOCIN to the physician.

c: the flow sheet, which displays a region of the conventional hard-copy flow sheet; the display includes columns for past visits and the physician enters data and receives recommendations in the right-hand column.

d: the soft key identifiers, labels that indicate the special functions associated with numbered keys across the top of the terminal keyboard.

ONCOCIN was developed by encoding all the Hodgkins and non-Hodgkins lymphoma protocols in use at the Stanford Oncology Clinic. As a test of the system's extensibility, we later encoded the chemotherapy protocol for oat cell carcinoma of the lung, and we updated the Hodgkin's Disease protocols when new versions were released late in 1980; these exercises demonstrated the generality and flexibility of the representation scheme we have devised.

USE OF ONCOCIN IN THE CLINIC

ONCOCIN was introduced in the Stanford Oncology Clinic in May 1981 and has been used by oncology faculty and fellows three mornings per week for the management of all patients enrolled in protocols for the treatment of Hodgkins or non-Hodgkins lymphoma.

After examining a patient, the physician uses ONCOCIN's on-line flowsheet (instead of the paper flowsheet) to review the time-oriented data from the patient's previous visits to the clinic and to enter information regarding the current visit. When the chemotherapy portion of the flowsheet appears on the terminal screen, the current column is already filled in with ONCOCIN's chemotherapy recommendation. An explanation of attenuation and dose calculation accompanies each drug so that the physician can judge whether to approve or to modify the recommendation.

The on-line flowsheet also contains sections for ordering laboratory tests, X-rays and scans, and for scheduling the patient's next visit. ONCOCIN fills in these sections according to the patient's protocol, but allows the physician to modify its recommendations. Once this information is approved or amended, it is printed at the clinic front desk in an encounter sheet for the patient.

COMPARISON WITH OTHER PROJECTS

Several computer-based oncology systems have been developed over the last five years. Most of these have focused on the development of clinical databanks for statistical analysis, often with special displays or prompts to help remind physicians about protocol details. The focus of of ONCOCIN project is somewhat different; our principal concern is to provide consultations, interacting with the physician directly, and thus to engineer the interface so that it is natural, fast, simple to use, and easily woven into the pre-existing fabric of clinic activities. ONCOCIN's emphasis on the symbolic representation of knowledge, on an ability to explain a line of reasoning, on the use of high performance hardware technology, and on the development of specially engineered interfaces for the physician, distinguish it from other related projects. We hope that these features will heighten its chances of being accepted by clinical investigators.

Another important distinguishing characteristic of ONCOCIN is its use of a knowledge representation technique that permits simultaneous encoding of judgmental expertise along with the algorithmic protocol knowledge. Our use of artificial intelligence (AI) techniques allows us to work on the development of consultation systems that combine formal protocol knowledge with the empiric knowledge of clinical experts who know how to optimally modulate therapy when unusual or aberrant situations arise.

ONCOCIN is designed to simplify the entry of data so that well-developed available statistical routines can then process them for protocol assessment. Analytical programs for assessing time-oriented patient records are already available to NCOG and to Stanford oncologists. Many of the other computer-based protocol systems have emphasized the development of the statistical routines to aid in protocol analysis. Since such programs are already available locally, this has not been a component of our work.

PLANS FOR THE FUTURE

The current ONCOCIN system is designed to help oncologists manage patients enrolled in experimental cancer chemotherapy protocols. We plan to build on this system in a number of ways. We plan to improve the system's performance on Hodgkins and non-Hodgkins lymphoma protocols by encoding the expertise of the oncologists who designed these protocols. This will enable the system to make appropriate recommendations even in situations in which the protocols do not specify what to do. We also plan to encode and implement for use by ONCOCIN the other commonly used chemotherapy protocols from our oncology clinic.

Finally, we plan to transfer the system from its current research computer to a professional workstation that provides a model for cost-effective dissemination of clinical consultation systems. This will enable us to introduce ONCOCIN gradually for ongoing use with all the clinic protocol patients, and to begin to prepare the system for dissemination beyond Stanford.

REFERENCE

Shortliffe, E.H., Scott, A.C., Bischoff, M.B., Campbell, A.B., van Melle, W., and Jacobs, C.D. ONCOCIN: An expert system for oncology protocol management. Proceedings of 7th IJCAI, pp. 876-881, Vancouver, B.C., August 1981.

Slide 1
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PERFORMANCE GOALS FOR ONCOCIN

1. Patient management advice based on:
   - formal protocol knowledge (core)
   - expert judgemental knowledge
2. Provide protocol directors with more complete and accurate data for analysis
3. Encourage hands-on use by physicians:
   - replace task already being performed
   - rapid, congenial interface
   - respect physician's hectic schedule
   - provide supplementary hard-copy reports (not previously available but useful for patient management)
   - maintain physician's role as ultimate decision maker:
     - give explanations for recommendations
     - allow physicians to override program's decisions

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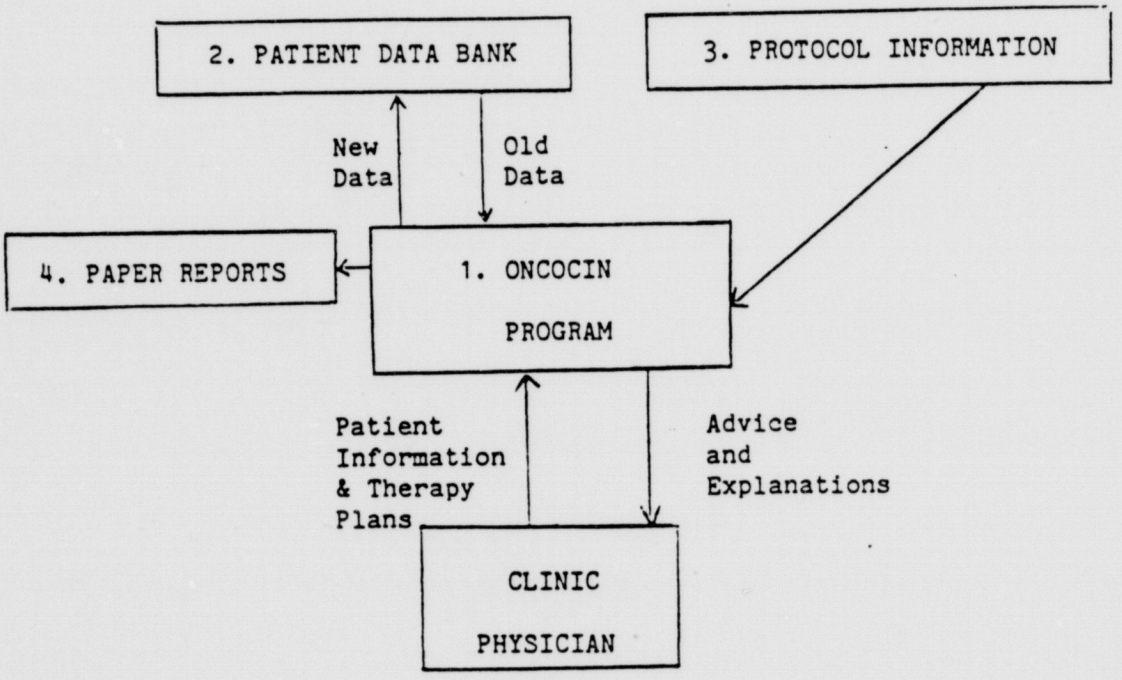
ONCOCIN: System Overview



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DATA ENTRY PORTION OF ON-LINE FLOWSHEET

Nodes above Diaphragm: 1- NED 2- Equivocal evidence of disease.
3- Partial regression since last "6" greater than 50%.
4- Partial regression since last "6" less than 50%.
5- No response since last "6".
6- Progression since last measurement or evidence of disease at study entry.
========== Weight from 1/23/81 (86 kgms) will be assumed for dosage ==========
calculations.

--Dz ACTIVITY--		20jun80	4dec80	11dec80	29dec80	5jan81	23jan81	30jan81
Upper Nodes	#	6			1		1	#
Lower Nodes	#	1			1		1	#
Spleen	#	1			1		1	#
Splenectomy	#	1						#
Liver Biopsy	#	1			1		1	#
Bone Marrow Bx	#	1			1		1	#
Lymphangiogram	#	1						#
IVP	#							#
CXR	#	6						#
Bone Scan	#							#
Chest CT	#	6						#
Echocardiogram	#	6						#

II	III	IV	V	VI	VII
DATUM NOT AVAILABLE	FOLLOW ITEM	DON'T FOLLOW	INSERT NEW ITEM	CHANGE OLD DATA	NEXT SECTION

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CHEMOTHERAPY PORTION OF ON-LINE FLOWSHEET

Give Alkeran, 14.0 mg. PO for 2 days.
[6.7 mg./m.sq. = the previous dose]
[100 % dose = 16.0 mg.]

========== John Doe === 12-34-56 ==========
The patient should receive chemotherapy PAVE-3A.

--CHEMOTHERAPY--		20jun80	4dec80	11dec80	29dec80	5jan81	23jan81		30jan81
BSA (m2)	#		2.0	2.0	2.1	2.1	2.1	#	2.1
OVERALL	#	6						#	
Karnofsky (%)	#	100						#	
PCV	#	48	45.4	42.8	39.1	40	39.4	#	40.4
WBC	#	11.2	9.1	6.8	6.9	4.5	2.1	#	6.6
Platelets	#	455	429	486	335	225	318	#	333
Combination Name	#		PAVE	PAVE	PAVE	PAVE	PAVE	#	PAVE
Cycle #	#		1 A	1 B	2 A	2 B	DELAY	#	3 A
Procarb., 100 mg/m2 POx7	#		200.0	200.0	200.0	200.0	0	#	200.0
Alkeran, 7.5 mg/m2 POx2	#		14	14.0	14	14.0	0	#	14.0
Velban, 6 mg/m2 IV	#		10	10.0	10	10.0	0	#	10.0

II	III	IV	V	VI	VII
DATUM NOT AVAILABLE	CHANGE OLD DATA	NEW DRUG	GIVE NO DRUGS	SELECT CHEMO	SEE SUMMARY

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SUMMARY OF ONCOCIN'S CHEMOTHERAPY RECOMMENDATION

========== John Doe === 12-34-56 ==========
The patient should receive chemotherapy (PAVE-3A).
Give Procarbazine, 200.0 mg. PO for 7 days.
[100 mg./m.sq. = 100% dose]
Give Alkeran, 14.0 mg. PO for 2 days.
[6.7 mg./m.sq. = the previous dose]
Give Velban, 10.0 mg. IV.
[4.8 mg./m.sq. = the previous dose]
If there is evidence of disease extension, consult with an Oncology faculty member or refer the patient to Lymphoma clinic.

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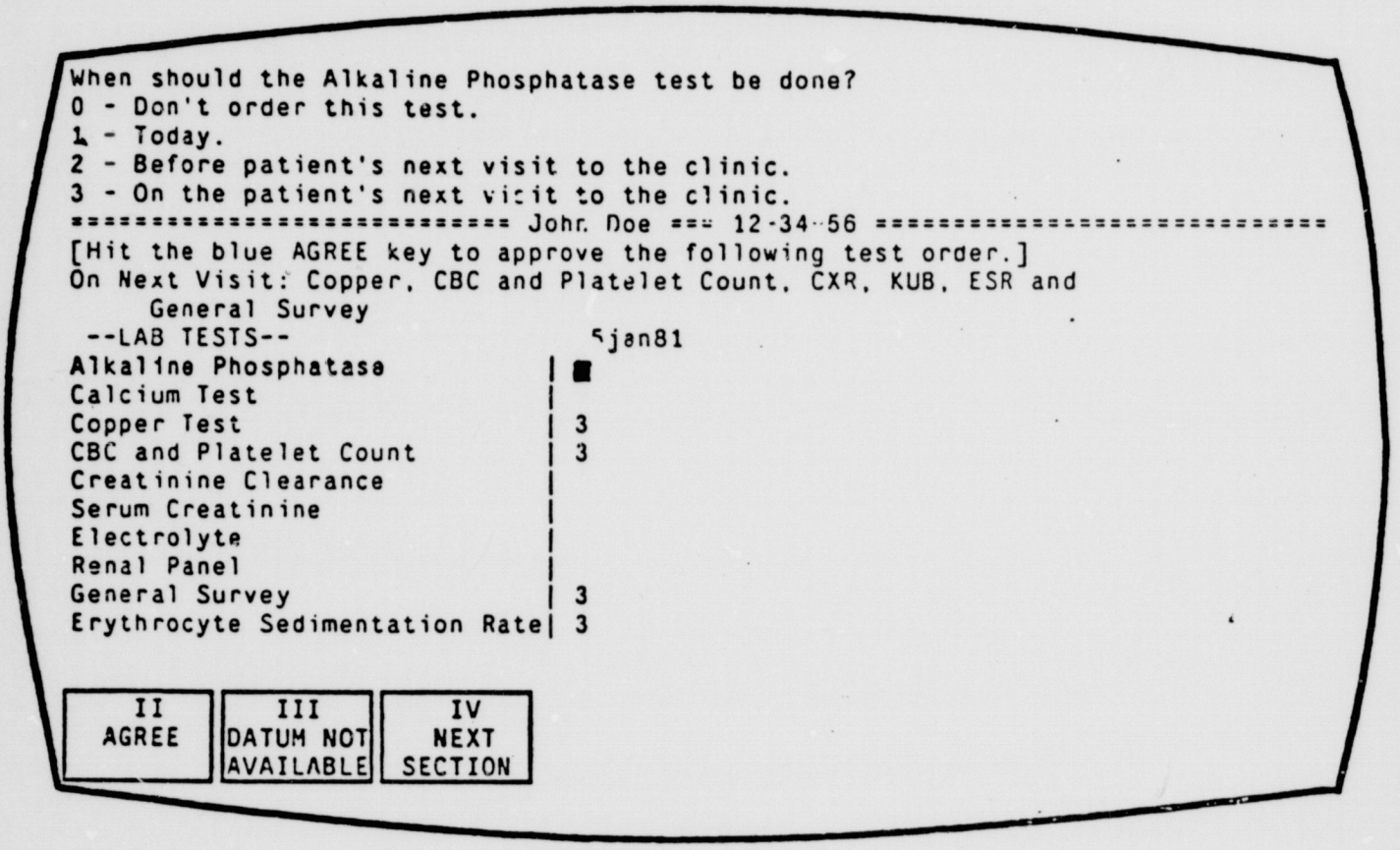
TEST-ORDERING SECTION OF ON-LINE FLOWSHEET



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SCHEDULING SECTION OF ON-LINE FLOWSHEET

If you are referring the patient to the Faculty Clinic,
please enter the number of days till the patient's appointment
at the Faculty Clinic.

========== John Doe === 12-34-56 ==========
Schedule next visit at Chemotherapy clinic in 3 weeks (on Monday,
January 26, 1981).

	5jan81
Delay permissible?	Y
Doctor for next visit	1 [Robert Carlson]
Days Till Next Visit	21
Days Till Lymphoma Appt.	
Days Till Faculty Appt.	
Other Tests	

--END OF FLOWSHEET--

II	III
END SESSION	DATUM NOT AVAILABLE