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A New Form of Medical Records for the Space Flight Program

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Introduction Although this project has continued for many months beyond the original ending date without additional funds, significant results have been obtained. The concept has been evaluated and modifications have been made to produce a more usable system. Tests with patients have been performed with good results.

The Concept. The medical record is a major problem in the health care system. It is fragmented, chronological, located in a single place and poorly organized. In NASA with health facilities scattered around the world and with personnel(astronauts) proceeding from place to place the problem is compounded. As long term missions are organized the problem will become more acute.

The solution for such problems appears to be simple. If the patient could carry with him into space or from one location to another, a permanent patient record which could be readily read and updated with simple devices, many of the problems would be solved. Such a record would have to fulfill certain conditions. It must be permanent which eliminates computer records, magnetic strips, or other techniques, it must be easily carried and it must be easily read and easily updated. Confidentiality is a criteria as is a simple means of reading and updating the information.

All of the problems have been solved by the optical card. The optical card is the size and shape of a standard credit card. Information can be placed on the card by means of a milliwatt laser beam which places digital information on the card in the form of dimples in the plastic surface induced by intense heat. The dimples are less than five microns in diameter and are spaced a few microns apart. The dimples are protected by a plastic over the writing surface and the cards have been carried for many months in wallets, pockets, purses, or automobiles without producing damage which made them unreadable. Some 2 million bytes(8-bit) can be placed on each card.

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Medical information is placed on the card in a highly structured format which permits data selection and organization by the software. Many screens present the data in the form of diagnoses, treatments, problem lists, drug lists, socioeconomic data, etc. and the data can be recalled in chronological or other sequences. Additional screens can be designed for special data. For example, we have designed screens for handicapped persons recording degree of disability, treatment, etc.

The cards are read and written upon with a simple device about 8 x 4 x 2 inches which accesses any personal computer through any SCSI port. Any personal computer can be used although we have used largely IBM formats. The system is inexpensive with present estimates that the cards will cost about five dollars each and the reader-writer will cost about $1000 in volume production. As all connections between parts of a health care system are made by the card, no mainframe or physical connection is necessary. The card is read by a laser beam which scans the surface of the card between two other beams which serve as guidelines to prevent misread. The card is written upon from the computer keyboard and the data is entered into prepared spaces on the screens. The speed of reading and writing is about that of the conventional floppy disc. A back up can be provided by producing a copy of the card, by dumping data to tape or disc, or by entering the data in a main frame.

Two adjuncts to the data entry are important. The system is designed so that a code word is required for any access to data. In addition, the data can be segregated to provide certain information only to pharmacists, nurses, administrators, etc. The code can be made as complicated as desired. Secondly, in addition to the ability of enter data in a formatted fashion, space is provided on every screen for the physician to enter personal comments as desired.

As the optical card is nothing more than a memory any digital information can be entered. We have placed photos, x-ray pictures, graphs, etc. on the card with no difficulty. This has not been done routinely because the typical x-ray requires about one million bytes for a high resolution image and this takes up too much space on the card. The restoration of the data by the computer is relatively slow process (minutes rather than seconds) and thus may not be practical for instant availability.

A summary of the complete system is provide by the attached paper. The cooperation of Sumitomo Corporation and CSK Corporation of Japan made the development of the system possible.

<u>Test and Evaluation</u> Once the card system hardware and software was developed, the system was placed under test. A community health center in

the Harris County Hospital District which had a flow of many different patient types was selected. The selection was based on several factors including the assistance of Dr. C. Vallbona Professor of Community Medicine at Baylor College of Medicine and manager of the community health services, the availability of physicians interested in working with the system and an administration willing to cooperate.

An operator was employed to transfer established patient records to cards including all relevant data. The files which were used were randomly selected from patients entering the clinic. Patients were given the cards and told of their importance. Some 135 cards were issued . For the next several months, patients were handled upon return to the clinic by the data on the cards. In no case did a patient return an unreadable card and in almost one hundred percent of the cases the patients returned with the card which answered two important questions: would the cards be damaged by repeated handling and would the patient return with the cards. Upon return to the clinic the patient as assigned to a physicians and one of two modes were used. If the physicians desired, the data could be brought up on the screen and the patient treated directly. If the physicians(and there are some) did not want to use the computer, the screens were printed out as requested for his/her use. The physicians notes and other information(lab data) was transcribed to the card by the operator from hand written notes before the patient left. Data which could not obtained before the patient left was placed on a duplicate card on file in the office and transcribed to the patient card at the next visit. The data transcription required some additional time (five minutes) on the part of the patient but there were no complaints. The patients when questioned indicated that the examination had gone more smoothly than usual, that less time was spent in he physicians office, and that fewer questions were asked all of which indicated a better data base for the physician .

At this point, it was felt that a more objective evaluation was necessary. In order to test the system, ten physicians who had no experience with computers were asked to participate. They were given the typical patient record, the patient record printed out from the screens, and the card itself and asked to perform a typical visit such as diagnosis, medication, determination of problems, etc. which were evaluated by a team of experienced physicians are presented in the paper by Shoda.

As a result of the recommendations of the tested physicians and our experience, the screens have been modified to provide better information. All of the physicians without computer experience learned to use the computer and the system in less than thirty minutes, due in large part to the software design which allows the operator to proceed from screen to screen or to amass tabular data with a single key stroke.

NASA Test Upon completion of the hardware and software, three units of each were delivered to NASA, Medical Applications Division, along with a supply of cards , for testing in that system. After testing NASA concluded that the system would not be satisfactory for their specific uses.

Other Tests A system has been installed in the VA in an outpatient system where medical records are now being placed on the cards. A system has been installed in school systems by the Texas Rehabilitation Commission to follow medical problems of handicapped children. A system has been installed in a physicians office and a hospital to follow obstetrical patients. The University of Texas Health Science Center is exploring possible use.

Diffusion of Technology The optical card system has attracted a great deal of attention. Several manufacturers including Optical Systems, Canon, Olympus, Sony, and others are attempting to devise workable systems. In so far as can be determined, we have the only tested working system (quote by Institute for Medical Records). We have received invitation to speak at symposia on medical records, optics, technology, health care, etc. Some 30 papers have been published(list attached). We routinely received dozens of requests for reprints from all over the world. We were invited to submit the lead article in *Computers in Biology and Medicine.* We receive an average of five phone calls a week from health care systems, physicians, and hospitals about the system although it has not yet been marketed. In each case we have indicated that NASA contributed to the development.

Future Development Although the NASA grant has expired, we are continuing our efforts. We have talked to school systems about using the system as a debit card- grade card-record card for all students, to manufacturers as an inventory system, and to hospital systems.

Enclosures:
1. General paper on optical card
2. Evaluation paper on optical card
3. Papers published(list)

PAPERS(Invited papers except where abstracts are indicated)

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