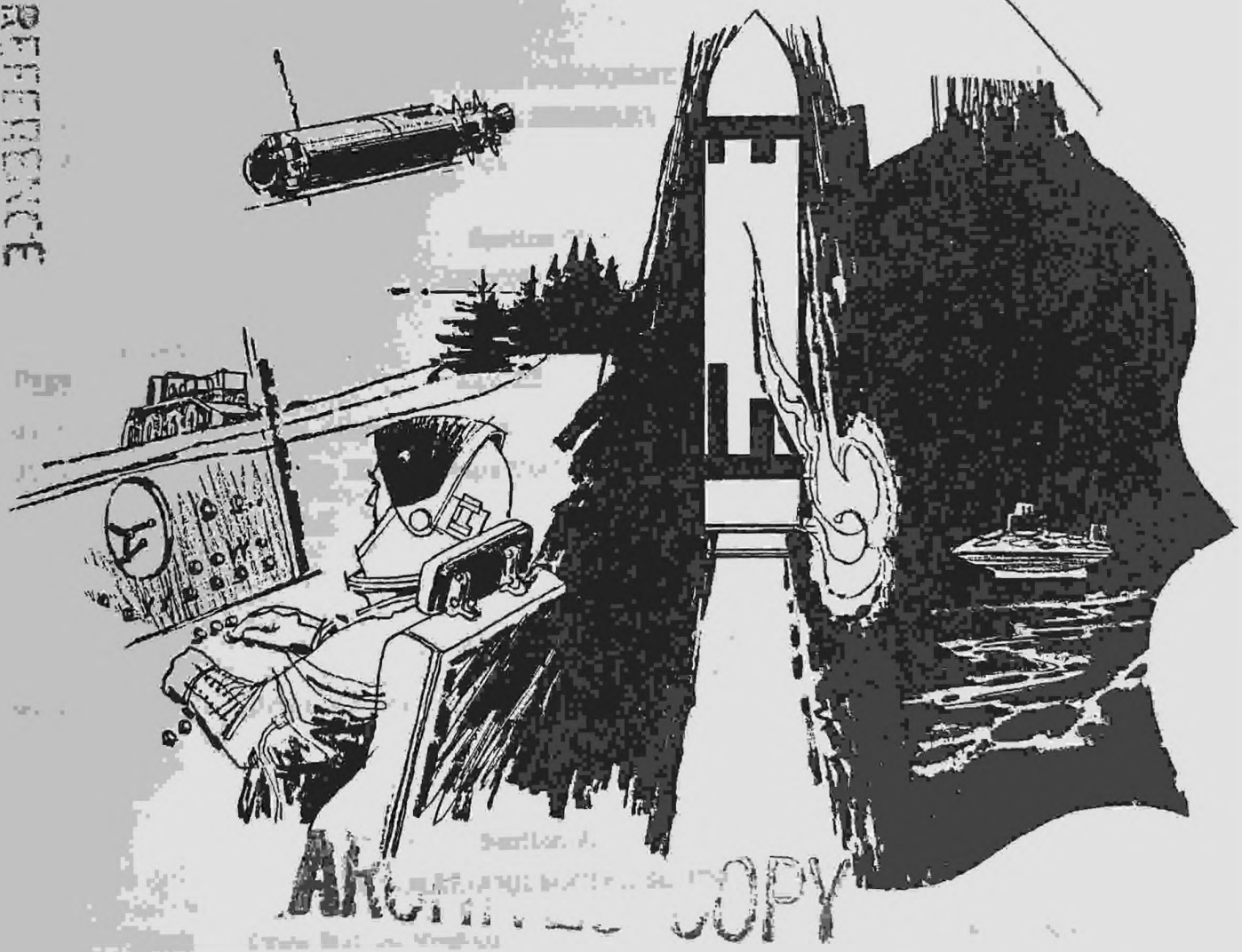
INDEPENDENT DEVELOPMENT REPORT FOR 1970 AND PROGRAM PLAN FOR 1971

March 1971 LMSC-D030345



LOCKHEED MISSILES & SPACE COMPANY

A Group Division of Lockheed Aircraft Corporation • Sunnyvale, California

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AERONAUTICS

Page	COSATI Code	Project	Funding 1971	Funding 1970
01-1	0103	Quiet Aircraft System	$255,000	$22,000
01-5	0103	Surface Effects Ships Control Systems	50,000	
		TOTAL	$305,000	$22,000

Section 04

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04-1	0401	Urban Air Pollution Model	$ 10,000	$ 9,000
		TOTAL	$ 10,000	$ 9,000

Section 05

BEHAVIORAL AND SOCIAL SCIENCES

05-1	0505	Crew Station Mockup	$	$ 32,000
05-3	0508	Control/Display Effectiveness Verification	55,000	16,000
		TOTAL	$ 55,000	$ 48,000

PROJECT TITLE					Project Number
Medical Information Services					This CFY 71D008 Previous CFY 8-3
Date 710101	Category Develop.	Related Projects This CFY			
Start Date 650101	Completion Date 701231	Related Projects Previous CFY			
Contact J. W. Baxter					Phone 742-5505
Principal Investigator K. T. Larkin Associate Investigator					Professional Man-Years This CFY Previous CFY 41.4
Funds This CFY	Labor	Materials	Other	Total	
Funds Previous CFY	Labor $1,086,000	Materials $99,000	Other $785,000	Total $1,970,000	
COSATI Codes	Primary 0612	Secondary 0502	Tertiary 0510		
Key Words	Medical Information; Medical Record Retrieval				

PROBLEM AND RELEVANCE

The Medical Information Services (MIS) originated as a general purpose storage and retrieval system appropriate for any application requiring high-speed entry and retrieval against a large data base. The handling of medical records was chosen as the first application for this information system concept because of the overwhelming record-keeping problems currently faced by hospitals.

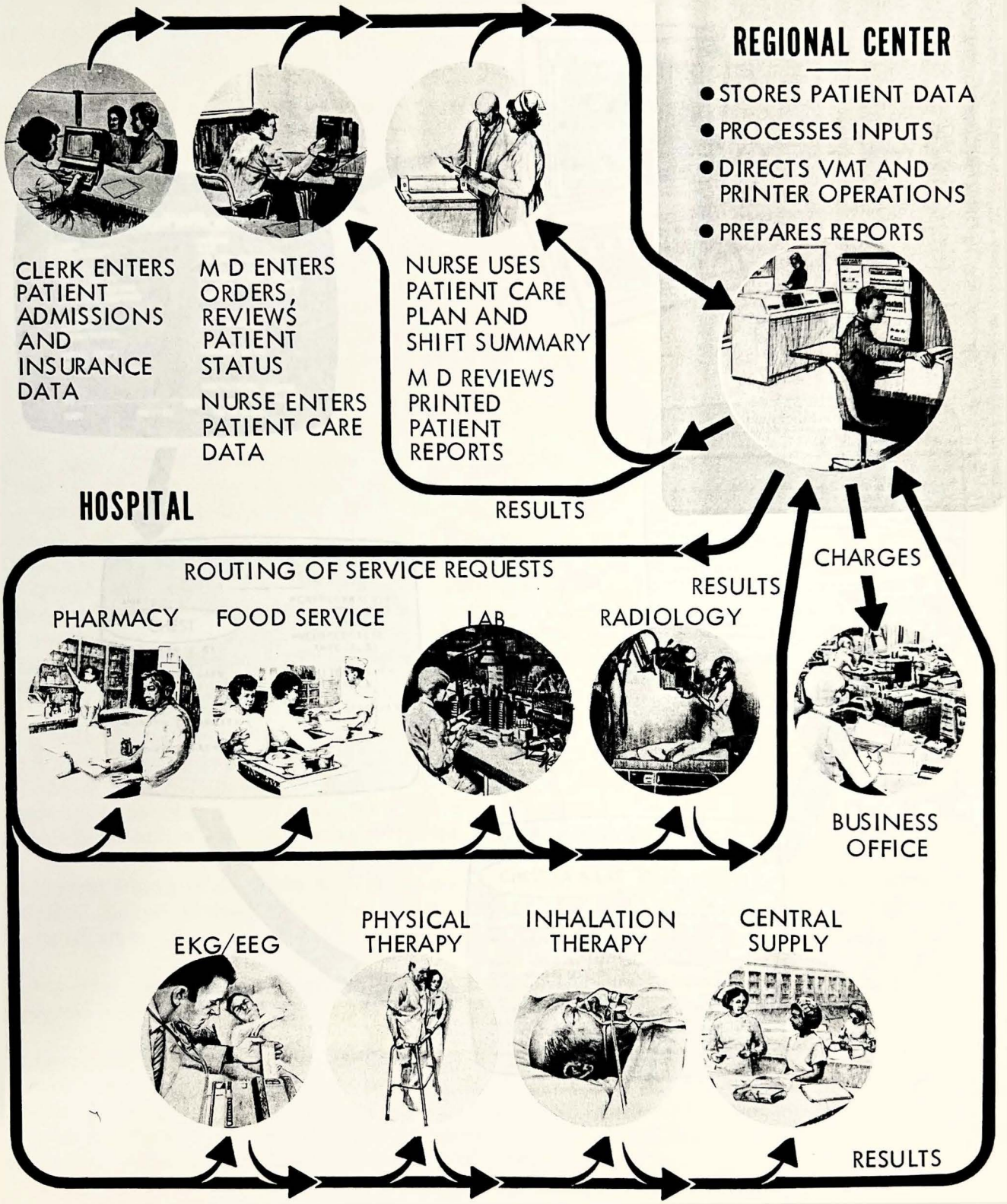
Although MIS applications are currently directed towards solving hospital data handling problems as a test program, (Fig. 06-5), work on the project has also led to the analysis of information system applications in other related user areas, such as military hospitals (medical command), health departments, nursing stations, and the U.S. Departments of Health, Education, and Welfare; Transportation; and Housing and Urban Affairs.

TECHNICAL OBJECTIVE

The primary technical objective of this effort has been to devise a real-time, comprehensive, automated, information-handling system utilizing video terminals (Fig. 06-6) as primary input devices, with each station having one or more terminals for entering data via a lightpen and keyboard and a printer for receiving data.

APPROACH

A basic computer storage and retrieval system appropriate for high-speed entry and retrieval against a large-scale data base is adapted to unique input control devices. Here a lightpen, keyboard, and video monitor are used to facilitate the generation of messages, orders, and reports with high reliability. The computer is set to check the data automatically for completeness and compliance with standards before routing into the system. The messages are directed automatically to proper stations within seconds. A series of secondary product lines are also developed from the messages.



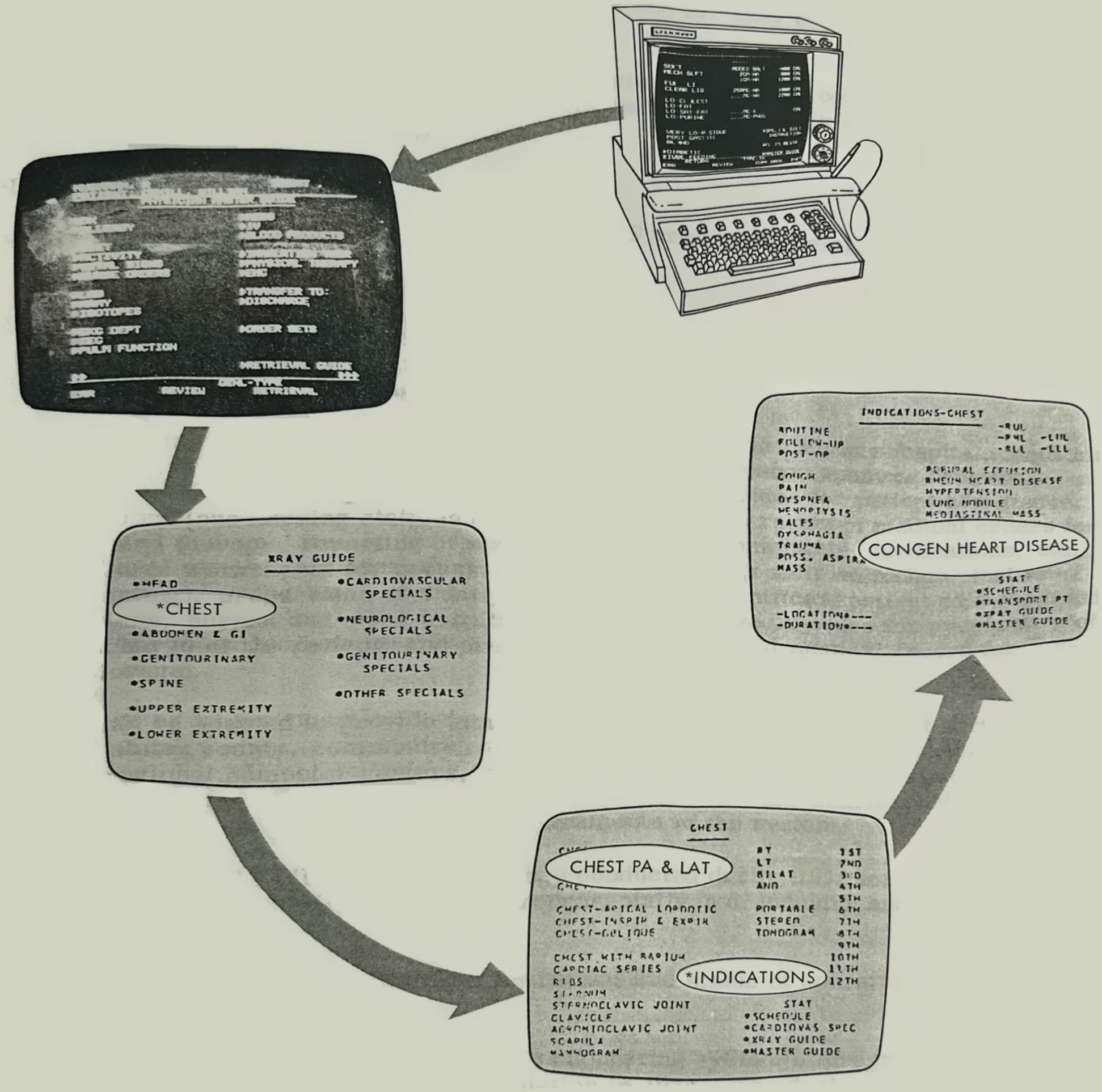


Fig. 06-6 Medical Data Input Routine

Redundant system elements are developed in the system to satisfy very high reliability limits. Modularity of various function entities is provided with interfacing elements for simple servicing and operation of the system and for easy expansion and flexibility of program modules.

The MIS consists of two major sections – a terminal handling program, and an applications program. A third priority partition is used for assembly of the programs and operationally for bookkeeping functions.

PROGRESS

During 1970, effort in regard to the following MIS project elements was accomplished:

- Pilot Hospital Operations
- Entry of Data Content (Video Matrices)
- System Design and Computer Programming
- System Hardware Support
- Education and Training Design

Pilot operation of the MIS system, initiated in 1969 at the El Camino Hospital, Mountain View, California, was expanded in 1970. Emphasis was placed upon the "customer-perceived" total system capability. The pilot system provides for patient admittance, transfer to various nursing stations or bed numbers, preparation of medical orders for diagnosis and therapy, reporting of status, vital signs, complaints, medications, etc., preparation of worksheets for necessary laboratory work (specimen pickup, test results reporting), preparation of a daily summary of all significant patient data recorded by physicians, nurses and other hospital personnel. It also provides for preparation of bills, discharge of the patient, and preparation of his official medical record for permanent storage.

The MIS can be adapted to provide total medical-information-management services to military, state, county, community, and university short-term general hospitals by means of regional computer centers, each serving a number of hospitals. Use of the regional concept is based upon the economics of computer time-sharing and the highly specialized operating and maintenance requirements of the system.

Demonstrations of the pilot MIS system were conducted during 1970 for physicians, nurses, computer specialists, and other representatives of industry and military installations.

Table 06-3 indicates the installation of equipment and status of operation in the pilot hospital at the end of 1970.

Programming efforts on the MIS (Version I) supporting system of programs and application programs was brought to near completion in 1970. The design is modular and involves extensive use of stored tables to vary the parameters in the system. Approximately 600 new video matrix displays were designed, installed in the system, and checked. This brought the total number of video displays in the system to 2,500 at year end.

The system of programs was designed to support multiple hospitals through the use of separate logical data sets. Two data sets were used – one for the prototype system at

Table 06-3

EQUIPMENT INSTALLATION AND USAGE

Location	Hardware	Usage
Nursing Station – 4 West	Video Matrix Terminal (VMT)	Physician entry of medical orders
		Nurse entry of telephone orders
		Nurse entry of patient data
	Non-Impact Printer	Printing of medical orders and patient data summary
4 West Conference Room	VMT	Physician and nurse training
Nursing Station – 2 West	VMT	Same as Nursing Station – 4 West
	TTY Printer	
Pharmacy	TTY Printer	Preparation of gummed labels for medication bottles
		Printing of such labels
Laboratory	VMT	Entering laboratory test results
	TTY Printer	Printing of laboratory requisitions
Radiology	VMT	Entering X-ray readings
	TTY Printer	Printing of radiology requisitions
EKG/EEG	TTY Printer	Printing of EKG, EEG, and physical therapy requisitions
Physicians Lounge	VMT	Physician training and practice
	TTY Printer	

the El Camino Hospital, and the other for a simulated hospital at the computer center.

Each programming module is an independent package capable of communicating with the other modules through simulated intercomputer channels on a polling basis. The four basic modules are the disk operating system (DOS), terminal handling, MIS monitor, and application programs.

The DOS is a standard IBM-supplied operating system and service package. Under normal conditions, it controls the flow of jobs through the computer, monitoring job streams and providing general executive functions. In the MIS, the DOS is used only to control input-output, to handle interrupts, and to perform partition swapping on a priority basis.

The terminal-handling monitor controls all interfaces with video display users at the El Camino Hospital. Significant efforts were directed at improving the man-machine interactions in the system. Effort is continuing to increase the number of users that can be simultaneously accommodated on-line. During 1970, work was completed in the following areas:

- Terminal Handling. Complete regional capability for handling 256 video terminals, using multiple disk packs and interface with remote printers, was developed.
- File Management. On-line table update by means of cards, tapes, or video terminals were developed and a task-dependent scratch file concept was implemented.
- Systems Monitor. The advanced version of the monitor, with core protection, complete task and system statistics, and full multiprogramming features, was developed and installed.
- Spooling System. A blocked record version of spooling with complete restart and reprint capability was developed. This software currently runs the operational system used at El Camino Hospital.
- Application Programming. Expansions to the software system tested at the El Camino Hospital were developed and checked out during the year. Interface of the MIS with the Business Office Services system (BOS), particularly in the area of patient billing, was another major accomplishment. New products added to the MIS system included transfer notices, admission notices, discharge notices, EKG reports, radiology reports, and pathology reports. A complete new laboratory subsystem is near completion. It will provide specialized worksheets for use in setting up and reporting laboratory test results. Periodic specimen pickup lists arranged in patient location sequence will facilitate the collection of specimens.

The major system support hardware activities during 1970 included the acquisition of plug-to-plug compatible peripheral equipment, the acquisition of non-impact printers, and the design and fabrication of a remote buffered multiplexer which concurrently distributes data to 24 remote printers.

Installation of a printer buffer multiplexer (PBM) permits remote printers to be driven over the same wideband communication lines which service the video matrix terminal in the hospital. Up to 24 printers can be driven concurrently from one PBM. Two PBMs are planned for each hospital, one for each wideband communication line. During 1970, the PBM requirements were specified, the unit designed, and the first unit fabricated.

Training plans and a series of Users Guide Books were prepared for reference use by physicians, nurses, and other personnel in daily operation of the MIS system. The training plans are customized to each functional area (e.g., nursing, laboratory, and

admissions) and include MIS system fundamentals, normal operating procedures, malfunction procedures, and familiarization routines.

The MIS prototype system is now undergoing a shakedown phase; and effort will continue toward improving the total system and, particularly, input/output speed and reliability. The follow-on development effort will now be undertaken by Lockheed's new "Information Systems Division."

Provenance note:

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the images were electronically enhanced and resized for readability and
then it was OCR'ed using ABBYY FineReader.

All uncertain words were verified but recognition errors may remain.

The Lockheed proprietary notice was overwritten.

T. Gardner
July 14, 2025