Hospital automation: Something more than a computer

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INTRODUCTION

The introduction of computer techniques into the hospital environment offers an exceptional opportunity to reassess traditions and procedures developed over the years of a non-automated era. However, there is an apparent danger that computer applications evolving in many hospitals tend to perpetuate the stereotyped roles of departments and personnel confined within traditional organizational boundaries. Their primary emphasis on conventional business or other specialized areas serves to sustain longstanding and often outmoded rituals and procedures, imbuing them with the aura of modern automation. Such stereotype can be avoided by centering design of the computer system on the patient and his care as the crucial basic unit, thereby optimally meeting the needs of both patient and staff.

This approach provides “something more” than mere automation; it reduces communication barriers by integrating and focusing the efforts of the administration and a diverse staff on optimizing the care of the patient; it encourages a redefinition of traditional duties and roles to minimize the functioning of human beings at repetitive, mechanical tasks which can easily proliferate with an unimaginative installation of data processing equipment; it encourages a fuller and more flexible version of the ultimate capabilities of computer technology in providing complete medical care.

This paper reviews and generalizes on the experience gained in the application of the patient centered concept to the implementation of a computer based information system in a 400 bed private psychiatric hospital, using an IBM 1440 computer and 12 Bunker Ramo cathode ray tube terminals for on-line service eight hours a day for the past two years.

The proliferation of computers in hospitals has been extensive. A survey made in the Fall of 1962 showed that only 39 hospitals were using computers. Four years later, January 1966, the American Hospital Association reported in their annual survey of “Hospitals Accepted for Registration” that 586 hospitals either had their own computer or received computer services through a service bureau. From the Fall of 1965 to May, 1968, ECHO, a national organization of hospital personnel engaged in the installation of computer systems, experienced a membership increase from 74 representatives of 49 institutions to 457 representing 241 private institutions plus numerous state and federal hospitals systems.

A review of current periodical literature and ECHO membership applications describing the status of hospitals’ automation programs reveal that the majority of operating systems emphasize patient billing, accounts payable, general ledger, payroll, inventory, and statistical reporting programs. A smaller number report the development of computer applications serving the research department or the clinical laboratory.

In the vast majority of hospitals, it appears that the implementation of computer services is under the direction of the comptroller, a comparable administrative officer to whom the data processing personnel report, a research scientist, or a laboratory technician. In relatively few instances is the responsibility for an automation program vested at an administrative level where the joint requirements of the whole hospital—clinical, research, business affairs—are seen in their proper perspective and can be effectively incorporated into an overall plan.

Considering those in whom control of computer programs is commonly vested, this concentration
of attention and resources in the more conventional and better understood uses of the computer for business or scientific purposes is understandable. Another factor which may contribute to perpetuation of this emphasis on specialized areas is the lessened likelihood that the status quo in clinical areas will be disturbed by the encroachment of computers on traditional doctor/patient/nurse relationships.

A study made by McKinsey and Company on the profitability of computers employed by large companies has clear relevance to hospitals attempting to secure maximum returns on their investment in an automation project. The study found that many large companies have unprofitable computer installations because "technicians", not "managers", control the ways they are being used. The report further states that unless companies go beyond the "super clerk" uses of computers and apply the machines to crucial management and operations problems, the heavy expense of a computer installation will probably not be justifiable.

From the findings of the McKinsey study emerge three fundamental principles pertinent to the problems and organization of a hospital:

1. The direction taken toward design of a computer project should follow what engineers recognize as the "Systems Approach". Simply stated, this calls for consideration of total systems needs before proceeding to the selection and design of compatible components.

2. Development of a hospital management information system calls for the commitment of the highest level medical and administrative staff to the direction and support of the project, thus securing a perspective which visualizes the relationship of the many functions, or sub-systems, of the hospital to each other and to the total needs of the hospital.

3. Interdisciplinary specialists should be members of the development team; i.e., physicians who understand the problems of data processing; researchers who understand the problems of the physician and the programmer; accountants who see the relationship between other hospital sub-systems and their own; systems specialists who can relate successfully to the other members of the group.

The Institute of Living patient centered information system has departed from the standard pattern seen in the majority of hospital systems which center around and cater primarily to a single component of the hospital complex or sets of isolated components. Adherence to the "Systems Approach" is exemplified in its stated objectives:

1. To provide a more effective method than otherwise possible through traditional means, to record, communicate, and display, when required, a comprehensive and dynamic profile of patient progress. This is accomplished through provision of simple inquiry procedures with which the user can extract an almost limitless variety of information through an on-line terminal.

2. To streamline administrative procedures, thereby freeing professional personnel for more productive purposes in the patient care and hospital management areas.

3. To increase the efficiency, economy, and safety of patient logistics; i.e., scheduling of medications, meals, diagnostic procedures, patient privileges, etc.

4. To provide a better and more sophisticated means to record, analyze, and present psycho-physiological data on all types of patients for clinical and research purposes.

5. To satisfy the need for financial, personnel, and other conventional business applications; i.e., payroll, accounts receivable, personnel data, financial reports, accounting, inventory control, etc.

Progress toward these objectives has been achieved in the implementation of a hospital dependent, reactive system which has been in daily operation for two years serving the clinical, administrative, and research needs. The system includes the following features:

1. An automated master patient record file of current and historical information on all in-hospital patients (see Figure 1).

2. Twelve key areas of the hospital are equipped with Cathode Ray Tube terminals with alphanumeric keyboards which hospital staff members use to update the patient file and request information as needed (see Figure 2).

3. A privacy feature has been incorporated to insure positive identification of a person attempting to operate a terminal and to prevent unauthorized personnel from entering or receiving privileged information.

4. The administrator, clinician, or researcher can request a report on any group of the hospital population according to desired parameters receiving an immediate reply; for example, sex, age, diagnosis, religion, origin, and/or length of stay. An example is shown in Figure 3.
5. Since daily behavioral observations are the basic laboratory data for psychiatric patients, a patient's behavioral status, over time, can be graphically displayed as desired using factors derived from an automated nursing note system, as shown in Figure 4. These "fever chart" displays have been found especially meaningful and useful to clinical personnel. Figure 5 is another example of a similar display comparing two patients on the factors derived from the scores achieved on the Minnesota-Hartford Personality Assay.

6. Computer aided instruction is provided through interactive procedural aids displayed on the terminal screens. Examples are the availability of a glossary to define terminology presented in an on-line mental status description and a self-administered test in the use of the newly adopted international list of diagnostic categories.

7. Automation of pharmacy orders provides a record of patient medications, produces labels for the pharmacist as a by-product, and notifies clinicians when it is necessary to renew a drug order.

8. Payroll, patient billings, census, and other related applications are also provided.

The programs, written in Autocoder, run on an IBM 1440 computer utilizing 16,000 characters of core storage, three 1311 disk drives, a 1442 card reader/punch, and a 1443 printer. A Bunker-Ramo 200 Display System provides the on-line capability with Bunker-Ramo 204 Display Stations and a Teletype Corporation Model 35 RO. By the end of the year it is anticipated the system will be transferred to a Univac 494 with central processor backup, Fastran drums and tape storage. The number of terminals will be expanded to approximately 40 in order to provide complete coverage of all hospital areas.

In retrospect, the following three premises on which system design philosophy has been based appear as crucial factors:

First, the patient, his care and treatment, have been recognized as the center of the hospital universe. Every activity is directed toward this end; no machine or automated procedure is permitted to disturb the therapeutic relationship between the patient and his environment.
INPUT REQUEST (CODED):
1. DATE RESTRICTIONS - MO./DA./YR. TO PRESENT
2. INCLUDE SEX/EQUAL TO/FEMALE
3. INCLUDE MARITAL STATUS/EQUAL TO/MARRIED
4. INCLUDE RELIGION/EQUAL TO/PROTESTANT
5. INCLUDE EDUCATION/EQUAL TO/ATTENDED POST-HIGH SCHOOL TRAINING

OUTPUT DISPLAY:

29049 MRS JONES, NELLIE R.
9A COLE GRAY, C. - T
35498 MRS SMITH, CLYDE C.
TO I GRAY, C.
44000 MRS TAYLOR, GRACE W.
W.H. SIMPSON, G. 0

UNDER 3 6 9 12 24 RES TO T
16.
20.
21.
22.
23.
2 0

UNDER 3 6 9 12 24 RES TO T
39.
49.
59.
6.
5.
REST TOTAL 3

AVERAGE LENGTH OF STAY FOR THE PATIENTS IN THIS GROUP IS 44 DAYS.

Figure 3—An example of the master patient file "extractor" capabilities

Figure 4—A longitudinal 25-day display of three nursing note behavioral factors for a sociopathic patient compared with the group mean (±50). Compared with the group mean, this patient was more socially adaptive and showed an increase in anxiety over the 25-day period. The psychiatrist believed that therapy would not be effective until anxiety had been mobilized.

Figure 5—A patient behavior profile produced by scoring twenty factors of the Minnesota Hartford Personality Assay. The normal profile is equal to a score of 50 on each factor with a standard deviation of 10.

Accordingly, from the point of view of both the systems engineer and the hospital, a patient centered information system provides the most logical approach to a viable system, as illustrated by Figure 6.

Secondly, the Human Factor is a critical element in the success of the computer project. The degree of
appropriateness and acceptability of new techniques is directly proportioned to the understanding and contributions of the users in their development.10

To this end, all levels of hospital staff, from top medical and administrative down, who might in any way come into contact with the system or be affected by it, have been involved in the design effort. This involvement has included on a continuing basis the following, as appropriate to the needs of the individual:

1. Exposure to the potential usefulness of computers in the care and treatment of patients through booklets, visual aids, lectures, group discussions, visits to other hospitals, etc.
2. Solicitation of ideas, even if apparently far-fetched, as to how a computer might be used in the hospital.
3 Assistance and advice in setting objectives and priorities for their accomplishments.
4. Active participation in the development of automated procedures by those involved; for example, pharmacists, nurses, the chairman of the pharmacy committee, and data processing personnel were closely involved in design and implementation of the automated medication file.
5. Frequent personal consultation by project staff members with the users of the system for their guidance and advice especially to ensure the proper use of the unique terminology employed by clinicians, nurses, and other professionals.

It has been observed that the mere involvement of key personnel from all departments can of itself improve hospital efficiency and patient care procedures, automated system or not.

Thirdly, the man/machine interface plays a vital role in the successful integration of an automated system into the hospital environment.

It is recognized that the users of the system need to enter, receive, and utilize information comfortably, effectively, and preferably without an intermediate filter, such as a clerk, ward secretary, nurse, or other personnel. For the majority of the hospital staff their only contact with the computer will be the means of communication. Quite literally, to them this is the computer.

In a more conventional business environment, a process control situation, or a computational research effort, such emphasis on choice of communications device may not be warranted. In these areas one can expect clerks, engineers, or scientists to be familiar with various types of terminal equipment. Where one must deal with personnel both unfamiliar with and often resistant to “machines”, a psychological, and often a physical, barrier is interposed to the free flow of information on which the system depends.

By centering the system on the patient rather than on the “computer”, new and productive patterns of staff interaction have been encouraged, leading to a re-analysis of every dimension of hospital operation that affects patient care. We conclude that the ultimate potential for applying the patient centered concept depends not on hardware which is already planned or available, but, most importantly, on capable medical, paramedical, research, and data processing personnel who can use the computer as a means and not an end for crossing traditional interdisciplinary barriers in the care of patients.

This does not mean the potential of the computer to monitor, condense, and analyze information is being relegated to a secondary level of consideration. With the acquisition of adequate third generation hardware we plan to use the data base now being accumulated for continuous monitoring by the computer for essential missing data, “essential” being determined by continuous comparison of already received data with paradigms of illness or treatment prediction patterns. We assume the essential information will vary considerably from one clinical problem to another, and hope to exploit the resources of advanced computer technology to make the models as varied and numerous as necessary.

We would judge that the ultimate success of an information system can be evaluated by the degree of increased communication and interaction it encourages amongst these various specialists; this criterion implies that all relevant judgments would be used in the care of the patient. Early evaluation of such a system at the Institute of Living demonstrated a significant increase in such communication.11 This approach has used the computer as something more than an instrument for automation.

ACKNOWLEDGMENTS

The computer project at the Institute of Living has been supported in part by NIMH Grant MH-08870, Bernard C. Glueck, Jr., M.D., Principal Investigator and Director of Research. This research was also supported by NIMH Grant MH-08557 and by the Gengras Foundation.

The authors acknowledge the assistance of Mr. R. Peter Ericson, Miss Dorthie McIntyre, and Mrs. Dorothy E. Reiss.
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