Effects of Computers on Patient Care

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In reviewing the specific topics of this lecture series, I was immediately struck by the fact that if computers have any impact on the practice of medicine, the organization and administration of hospitals and health care facilities, or on general medical research, it must follow that computers will have an effect on patient care. After all, patient care is essentially the output of a system which has medicine, research, and administration as its inputs. If, through the use of computers, any one of these inputs can be aided, a beneficial effect on patient care should result. You have heard thus far that there are many outstanding benefits which can be achieved through the use of computers in the practice of medicine as well as in general medical research.

Development of Hospital Systems Analysis

I am sure that by now you are all aware of the marked current interest in the use of electronic data processing, operations research methodology, and many industrial engineering techniques in hospitals. However, I believe that a little historical development would help to set the stage for my discussion today, as it might focus your attention on what I consider to be some of today's problems. You will probably be amazed to learn that one of the first persons interested in designing better patient-care systems was none other than the founder of the concept of motion study and one of the fathers of the scientific management movement, Dr. Frank B. Gilbreth. He made extensive studies of management in many hospitals throughout this country and in Europe. In addition, he conducted many method studies in operating rooms in hospitals in this country. In 1916, in a paper presented to the AMA, Gilbreth stated "In studying these many hospitals, we find conditions, as a rule, much worse from a managerial standpoint than in the average factory, and some hospitals are so bad that they should actually be closed immediately." Remembering the conditions that existed in the factory system in the early 1900's, you will probably get the full impact of Gilbreth's criticism. He went on to point out that there were no reasons that present management and systems in hospitals could not be revolutionized; that the waste in transference of skill in surgery could not be eliminated; and that the methods proven in industry could not be applied to the hospital. A little spark of interest was triggered by Gilbreth's discussion when Pool and Bancroft (1917) described a system study of a surgical service in which many concepts of today's operating suites were discussed and presented. It was over 20 years before Lawrence and Berry (1938) made the next appeal for the use of industrial motion study principles in the operating room.

It was still to be several more years before any real activity was to take place. Surprisingly enough, the nursing profession began to champion the cause of designing better patient-care systems. Two nurses at the University of Minnesota School of Nursing were interested enough to attend classes in motion and time study at the University's School of Engineering. They began to put into practice some of the principles that they had learned (Dodds, Petry, and Koepke, 1940). About the same time, Dr. Ralph Barnes, a pioneer industrial engineer, carried out several studies at the University of Iowa College of Dentistry (Speidel and Barnes, 1942), and Dr. Lillian Gilbreth (1945) made another appeal to hospital administrators, which was essentially the same as her husband had made 30 years before.

However, it took World War II with the shortage of nursing personnel in the post-war years, the sharply rising costs of patient care, and the changes in the pattern of patient care to really awaken the hospital world. About the same time the operations research star began to rise, as the use of the computer made possible solutions to mathematical problems which could not have been solved previously. The slow awakening of hospitals to modern management methods took place over 35 years after the initial discussions about the patient-care system by Frank Gilbreth.

Computerization of Clinical Data

Now if we consider scientific management a revolutionary movement, you might ask what difference does it make *when* we jump

on the bandwagon, just as long as we jump. There is a difference, and this is one of the two significant points that I would like to leave with you today. It is exceptionally difficult to jump on a rapidly moving vehicle without first accelerating to an equal speed. Industry has had over 40 years to adjust to the gradual changes which create the proper environment and a receptive attitude for the use of new management technology, such as computers.

Unfortunately, many hospitals today view the use of computers as a panacea. In one respect, nothing can be further from the truth in the patient-care system. Simply replacing the current information system by computers may result only in an amplification of the speed by which "garbage" is processed. The effect that this type of approach has on patient care may well be a negative one. Hospitals must first accelerate to the pace of the bandwagon.

In order for computer applications to have the most beneficial effect on patient care, all patient-care systems must be carefully studied and evaluated. Let me define what I consider a patient-care system. A patient-care system would include the physical activities required to carry out a function or goal, together with the accompanying information systems that are related to those physical activities.

As I have said, all patient-care systems must be carefully studied and evaluated. In effect, I am imploring you to eliminate the "garbage" and the "noise" initially. In order to do so, the patient-care system must be studied carefully, and system decisions must be based primarily on the patient as the center of activity, and not the computer. In many cases, the physician's order supplies the goals to be met by the patient care system. These goals must be carried out within the context of the entire hospital operation. Although I may

have implied that the physician's order may be considered a goal or a set of functions to be achieved, I *do not* imply that the method for achieving these goals is restricted. For example, coming to Richmond may be considered to be an explicit goal, but you know that there are many methods of transportation and many routes to follow that would satisfy this goal. Thus, in a hospital system, for example, requiring a specific medication T.I.D. is one thing, but deciding how the prescribed drug is to reach the correct patient at the specified time is something completely different. The careful study and design of which I speak requires a consideration of the possible alternatives and a selection of the one most feasible to carry out the specific function in question. Hospitals have been quite remiss in carrying out this type of activity.

Design of Hospital Computer Systems

I might add that restudy and re-evaluation is also a necessary component of system studies to keep up with the many changes in medical technology that are introduced into the patient-care system. This same approach or philosophy must permeate the indirect care systems as well as the direct care systems.

This atmosphere of study and design is a spiraling one. It is similar to the variance between fire-fighting and fire-prevention. Most people associated with hospital management find themselves constantly problem solving or in a fire-fighting situation. They have little time for planning or fire prevention, and the less time they spend in fire prevention, the more fires they will have to stamp out. This usually continues as a downward spiral.

The concept of proper design of a patient-care system can be an upward spiral as opposed to a downward spiral. If one first takes the time to properly design a pa-

tient-care system or a component of a patient-care system, the number of difficulties or problems will be fewer, thereby providing more time to spend in design.

The study and design of hospital systems is, of course, no easy matter, nor one that can take place overnight. The use of computers as an information processing medium must be included as a part of the system studies, if greatest effectivity is to be achieved. The capacity for computer performance is great, but it is always dependent upon the imagination and the sophistication of its man-made programs.

Current Uses of Computers

The effect that computers have on patient care will depend on their mode of operation. Computers may be called upon to process information "after the fact" or after required action has been taken, or they may operate in real time or "on line" with the events as they are taking place. Most of the computer applications existing in hospitals today are of the former type. They have been focused on business office or fiscal affairs and on certain medical statistics. These types of computer operations are essentially after-the-fact manipulations of stored information. It should be pointed out that many of these applications are exactly the same as their industrial counterparts, and the transformation of industrial programming was easily accomplished, since the industrial system, in many cases, had been re-evaluated and redesigned with the eventual use of computers in mind. We find such applications as accounts receivable, accounts payable, hospital payrolls, patient ledgers, and general ledgers. The use of computers in these applications has facilitated the hospital administrator's business-office operation, and has provided for greater accuracy in patient billing and, hopefully, for reduced operating costs. To the extent that these activities

were achieved, patient care in a general sense was improved.

The computer evaluation of certain medical statistics provide information that perhaps was not previously available. A good example of this is the service offered by the Commission on Professional and Hospital Activities. Hospital case history data is processed to compile routine statistics on discharged patients, as well as to index cases by diagnosis, operative procedure, physician, etc. Comparisons of data which can be made could result in improved patient care. For example, one could evaluate the length of stay of patients with the same diagnosis, and possibly infer a more successful treatment modus operandi. Computer storage of large masses of data, such as those found in the medical record, patient index, physician index, disease and operative index, etc., will be of great benefit in the development of computer-aided diagnosis and eventually in improved patient care. However, these applications to a certain extent are still in the research stage, and their implications to patient care really remain to be seen.

The most exciting and probably the most beneficial effect on patient care will be achieved in the use of the computer in clinical activities within the hospital in real time. In these applications, data is being continuously fed into the system, and processed results are continuously available. This feature is especially important to the hospital, as hospitals are faced with extremely difficult problems of logistics. These problems are magnified due to the communications required by the very large number of departmental interrelationships and more importantly, the system perturbations caused by wildly fluctuating demand for services and facilities.

A computer operating in real time is well-equipped to consider both of these peculiarities. It can not only take them into considera-

tion but can rapidly respond to them. The problem of communications begins with the physician's order and permeates the entire system, as various services are brought to bear in the treatment of the patient. In the first place, the correct transmission of the physician's request to all the agencies will be a step forward in improving patient care. In addition, as Dr. Brandt pointed out, computers can receive directly many of the physiological measurements about the patient picked up by monitoring devices. They can provide programmed responses such as alarms when out-of-control conditions develop.

One should go through all of the departments of the hospital to really see how this type of computer application would affect the performance of each and every service area. In short, I would suggest that if you would visualize the accurate transmission of information and the immediate feedback of results facilitated by computers coupled with properly designed physical performance systems, you would see an image of the dynamic hospital system of tomorrow.

In my opinion, the most beneficial impact of computers on patient care rests primarily in the better control made possible by the use of the computer. This control in essence provides medical care as prescribed by the physician with the minimum amount of error and delay. The problem of how to prescribe the care is the physicians' problem. The hospital patient care system must take the instructions which the physician provides and operate on that input in such a way as to develop outputs which accurately reflect the mission of the hospital.

Summary

In conclusion, the computer alone is not enough to provide the best possible patient care. Every hospital must be introspective

about each patient-care system so that the performance aspects of the systems are meaningful and efficient. Couple the best methods of performance with the information processing and control capabilities offered by the computer, and one can envision a smoothly functioning patient-care complex in which the wild perturbations one sees in today's hospital operation are minimized. However, medical care finds itself in an awkward dichotomy. Many of the causes of system perturbation in the hospital are directly related to the demands for and implementations of new medical research results and technology. This of course, we must aid and abet to the best of our ability, so that patient care is continuously improved. While we struggle to keep the patient-care system under control, on the one hand, we must at the same time encourage the new procedures and techniques which of necessity bring about greater perturbations. It is only by welding together the best possible performance and information system that we can provide the opportunity for improving patient care. Thank you.

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