



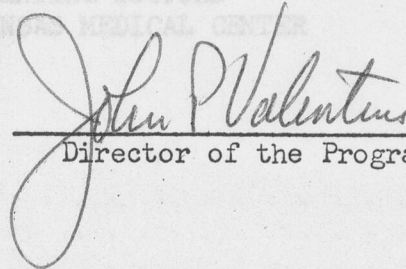
A STUDY TO DETERMINE  
THE MOST EFFICIENT SYSTEM  
OF GENERATING AND IMPLEMENTING DOCTORS'  
ORDERS AT THE UNIVERSITY OF KANSAS MEDICAL CENTER

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August, 1969

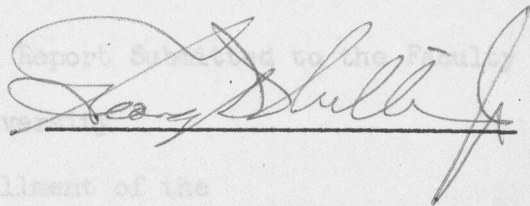
APPROVED BY THE U. S. ARMY MEDICAL FIELD SERVICE SCHOOL:

THE MOST EFFICIENT SYSTEM  
OF GENERATING AND IMPLEMENTING DOCTORS'  
ORDERS AT THE UNIVERSITY OF KANSAS MEDICAL CENTER

  
Director of the Program

APPROVED BY THE PROJECT ADVISOR:

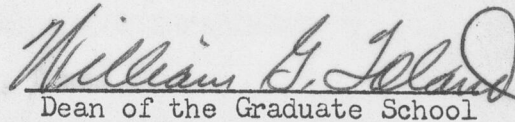
A Problem Solving Project Report Submitted to the Faculty of  
Taylor University

  
In Partial Fulfillment of the  
Requirements for the Degree

Master of Hospital Administration

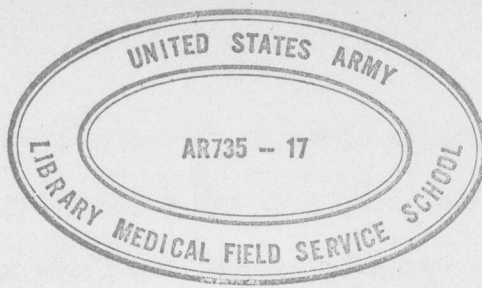
APPROVED BY THE GRADUATE COUNCIL:

Colonel Charles C. Hayes MC

  
Dean of the Graduate School

August, 1969

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CHAPTER I

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## CHAPTER I

### INTRODUCTION

#### General Information

Hospitals throughout the nation are faced with a burgeoning requirement to provide for the care of more and more patients. This task has arisen as the direct result of the increased demand by the public for greater and better health benefits, the increased awareness that health care is the right of all, the increased numbers of patients provided for by state and federal government funds, the increased numbers of patients provided for by third party payment by commercial insurers, and the technological developments that permit a broader spectrum of diagnostic capability.

An increased number of patients as referred to above leads to a greater workload for the radiology, laboratory, and other supporting diagnostic service departments. A significant portion of the total cost of patient care is reflected in the cost of these services.

There has been a general clamor from the public and an investigative effort by the government to reduce the multiplying cost of hospital care.

An increased demand for services is generated by the orders that the doctors write for their patients. Upward trends in the number of orders written for patients is generally the experience in governmental and civilian hospitals throughout the nation.

University teaching hospitals generate a larger number of doctors' orders than non-teaching hospitals for four main reasons:

1. The teaching staff and faculty of university teaching hospitals are of professorial rank and are, in many cases, nationally recognized physicians. A large number of their patients are referred from long distances as diagnostic problems, and this type of patient usually requires an exhaustive study to determine the cause of his medical problem.

2. Medical students, interns, and residents are just beginning their careers in medicine and have not yet developed the level of diagnostic acumen that will permit them to order only those studies that are diagnostically indicated. Doctors in training learn to consider all the diagnostic possibilities, even though remote. The academic environment of the teaching hospital, with its diagnostic problem cases, the unusually gifted professors, the curious and searching attitude that prevails, and the atmosphere of scientific problem solving leads the young doctors to order studies to rule out the bizarre diagnosis. Teaching professors are reluctant to discourage the doctor-student's motivation to learn by requiring him to cancel procedures he has already ordered.

3. One may occasionally find an attending staff member whose approach to teaching is one of castigating the student who commits the error of omitting a study that was indicated by the symptoms and findings in a particular case. The indication for ordering the study is clear and obvious to the more experienced physician, but may have been obscure to the student. All too frequently the reaction of the intern or resident is to order a complete battery of studies on all subsequent patients while he is assigned to that particular attending staff member.

4. The academic environment of the teaching hospital lends itself

more toward the teaching objective of the institution than to the economic impact of a multitude of requirements generated by doctors' orders in the name of diagnostic perfection.

Requirements generated by doctors' orders boost hospital operating costs and patient charges by:

1. Increasing the number of personnel required to do the work, thereby producing a larger payroll.
2. Increasing the equipment and supplies required to do the work.
3. Increasing the length of patient stay in order to get all the requirements completed.

Those responsible for the administration of the hospital are vitally concerned with the cost of operating the institution. They are continually monitoring costs and looking for ways to increase service through better management and more efficient operation.

Within the total range of factors that contribute to hospital costs, how may this particular segment of hospital costs be reduced? For the administrator to attempt to reduce costs by reducing the requirements generated by doctors' orders would not only infringe upon the physician's just and traditional right to determine what is needed for his patient, but would also impair the ability of the faculty to accomplish its primary teaching mission, and quite possibly get the administrator fired! His logical alternative is to devote his efforts toward increasing the efficiency of the operation through better management.

These considerations are the primary ones which prompted the present study.

<sup>2</sup>Ibid., pp. 1-3.

The Hospital Setting and History

The University of Kansas Medical Center is the major medical, diagnostic, treatment, and research-educational facility of the State of Kansas. It is the site of the University of Kansas School of Medicine, which was founded in 1899. The Medical Center is located in Kansas City, Kansas.

The interrelated purposes of the Medical Center fall into four categories: (1) teaching, (2) patient care, (3) medical research and (4) community service.

Teaching was the founding stone of the Medical Center. With about 740 faculty members and 1300 students, it remains the institution's primary guiding force. Allied health personnel trained at the University of Kansas Medical Center include radiologic technologists, medical technicians, licensed practical nurses, dietitians, social service workers, occupational, physical and inhalation therapists, speech pathologists and audiologists, morticians, and hospital administrators.<sup>1</sup>

In addition to the medical school, the Medical Center houses one of the major schools of nursing in the state. There are about two hundred resident physicians in specialty training programs, and twenty-one interns. The annual operating budget is over seventeen million dollars. Its finances come partly from state taxes (27%) and partly from such other sources as grants, gifts, and income (73%). There are about four hundred and fifty professionals on the clinical staff. These are primarily physicians who are in practice and who donate some of their time to teaching programs.<sup>2</sup>

In FY 1967 the Medical Center assisted with, directly provided, or administered the following: 9,000 surgical operations, 1,600 deliveries of babies, 14,000 physical therapy treatments, 30,000 occupational therapy

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<sup>1</sup>Office of Informational Services, Facts and Figures about the University of Kansas Medical Center (Kansas City: University of Kansas Medical Center, March 1, 1968), p. 1.

<sup>2</sup>Ibid., pp. 1-3.

treatments, 58,000 x-rays, 3,000 other radiological procedures, 1 million laboratory determinations, 9,000 blood transfusions, 3,000 electroencephalograms, 15,000 electrocardiograms, 140,000 prescriptions, 10,000 anesthetics, and over 1 million meals--all of which required a doctor's order.

#### Conditions Which Prompted the Study

The administrators of the University of Kansas Medical Center are a talented, forward-looking group who are intimately aware of the problems faced by the nation's hospitals. They have noted the upward trend in the number of procedures that are generated by doctors' orders at their institution. They have noted an increasing degree of dissatisfaction by both professional and administrative personnel with the present system of generating and implementing doctors' orders at staff meetings, on the nursing units, and in the service departments. Patient complaints directed at long waiting times, missed or late meals, and extended hospitalization have become more frequent.

The administrators, in coping with the rising costs of hospital care in their institution, are searching for ways to increase efficiency and at the same time lower costs. They have a fairly sophisticated system of automatic data processing, the use of which is continually being expanded into additional areas of the hospital operation.

Faced with these considerations, the administration recognized the need for an objective analysis of the present system of generating and implementing doctors' orders by an outside doctor-observer, and stated their original problem as follows:

Analyze the system of writing physicians' orders continually throughout the day, and determine the reasonable needs of Nursing service, Dietary, Radiology, Laboratory, and the other service departments for these orders at specific time periods, to determine

if rescheduling is necessary to assure adequate provision of service and coordination between departments.

#### Statement of the Problem

The problem is to determine the most efficient system of generating and implementing doctors' orders at the University of Kansas Medical Center.

#### Objectives

The objectives of the study were established as follows:

1. Determine the magnitude of the service department workload that is produced by doctors' orders.
2. Study, analyze and define the present system.
3. Identify the problems posed by the present system.
4. Formulate two alternative systems which may solve the problems posed by the present system and which can be implemented and accomplished.
5. Analyze, discuss, and compare the advantages and disadvantages of each system.
6. Design an implementing system for the radiology department that can be used by the other service departments in implementing the alternative systems.

#### Criteria

A satisfactory solution to the problem posed in this study must satisfy the following criteria:

1. Minimize the time the patient is absent from the nursing unit and therefore available for study by other service departments.
2. Reduce to a minimum the time required to work up, diagnose, and treat the patient.
3. Provide a means for planning the patient's diagnostic and

treatment program in advance so as to obtain maximum utilization of medical resources.

4. Reduce to a minimum the time the nurse must devote to duties other than patient care and management.
5. Minimize the number of changes and additions to doctors' orders.
6. Minimize the number of telephone calls required to accomplish the patient's diagnostic work up.
7. Reduce to a minimum the number of missed or delayed patient meals and appointments.
8. Reduce to a minimum the time required to get the report of a diagnostic study to the doctor and thereby produce better patient care.
9. Reduce to a minimum the time a patient has to wait prior to and following a diagnostic study.
10. Provide a means of control over the flow of patients to and from the service departments.
11. Provide a means of reducing to a minimum unnecessary congestion of patients enroute to, present in, and returning from the service departments.
12. Provide a means for the nursing unit personnel to know at all times the location and probable time of return of a patient to the nursing unit.

#### Factors Bearing on the Problem

The new chairman of the radiology department will join the Center in August, 1968. A radiology scheduling system is in use at the hospital where he is presently located. A centralized or decentralized departmental scheduling system is desired by the new chairman.

A sophisticated system of automatic data processing supported by

computer is currently in use at the Center. It is presently used for payroll; billing; patient data, records, and accounts; and certain research requirements. Plans are complete and priorities established for automating the management and reporting of laboratory data. A complete hospital information system is programmed for the future. The additional equipment required for a centralized scheduling system can be on site in six to twelve months.

### Assumptions

1. A genuine desire to improve the present system of generating and implementing doctors' orders is extant.
2. A centralized or decentralized scheduling system for all requirements resulting from doctors' orders is acceptable to the professional and administrative staff.
3. Funds will be provided and required materials procured to fully implement a system of scheduling total service department requirements.
4. Requirements for service departments will remain at the present level or increase.

### Research Methodology

To determine the magnitude of the service department workload that is produced by doctors' orders, an analysis was made of the procedures performed by the Radiology Department, Laboratory Department, Electroencephalogram Service, Electrocardiogram Service, and the Consultation Service of the Medical and Surgical Departments and their allied and subordinate services for fiscal years 1965 through 1968. The data for FY 1968 is a projected figure based on actual data for the first three

quarters of the fiscal year. performed during these hours. Data was

The present system of generating and implementing doctors' orders was defined by:

1. Observing events occurring on two different internal medicine wards and one general surgical ward.
2. Observing events occurring in the service departments listed above.
3. Conducting formal interviews and informal discussions with administrators, department heads, faculty members, attending staff, medical students, interns, residents, nurses, ward clerks, aides, medical technicians of the different service departments, secretaries, and patients.
4. Preparing a flow-chart to show the succession of events which occur in the processing of a patient from admission to discharge.
5. Reviewing patient charts and studying the successive steps which took place in the implementation phase of doctors' orders.
6. Soliciting opinions, thoughts, and ideas concerning possible solutions to these problems posed by the present system from the individual members of the staff who worked daily with the system.

In designing an implementing system for the alternative solutions to the problem, certain basic data were found to be necessary. The magnitude of the annual workload and a thorough knowledge of the diagnostic radiology operation was obtained in the steps discussed in the preceding paragraphs. The magnitude of the daily workload and essential time studies to determine standard time values for each type of diagnostic procedure performed in the Radiology Department were determined by means of a four-day time study between 0700 and 1600 hours each day. Nearly all of the procedures requiring fluoroscopy and the largest portion of the

daily workload are routinely performed during these hours. Data was thus obtained on 346 procedures. Each patient during this study period was logged into the department, into the diagnostic room, out of the diagnostic room, and out of the department. This procedure enabled the investigator to determine total time in the department, waiting time in the department before the diagnostic study was begun, the time each type of procedure took, and the waiting time in the department after the study was completed.

Data for workload determinations was obtained from a multitude of sources, including computer printouts, service department work-logs, administrative periodic and annual analyses of operations, and experience data from the service department personnel.

For details of a decentralized departmental scheduling system that now can be used by other service departments (see Appendix).

### Literature Review

A review of the literature during the past twenty years revealed no evidence of any previous consideration of the subject of generation and implementation of doctors' orders.

Pertinent information used in the study centered around scheduling systems currently in use, administrative and management considerations, advancements in computer science that have hospital application, and information of general interest concerning the efficient and successful programming of patient care.

### Scheduling systems

Key references concerning scheduling methods are cited. The

authors<sup>3</sup> point out the shortages in trained personnel, the increasing demands being placed on supporting services in the hospital, the lack of control over the demands of the various departments who request service, the traditional inefficiency and lack of organization of service departments, and the burgeoning need for scheduling the daily workload. The different methods of scheduling are discussed as applied in their particular institutions.

Administrative and management considerations

Sigmund<sup>4</sup> and Fuchs<sup>5</sup> write in some detail concerning costs of hospital care and discuss at length economic considerations involved in lowering the operating costs of hospital health care.

Welch<sup>6</sup> in a comprehensive treatise, goes into a multitude of considerations of technical, professional, and administrative matters in organizing and operating X-ray departments.

Cadmus<sup>7</sup> discusses considerations concerning the most efficient

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<sup>3</sup>Dov Kanon, "Scheduling System for X-rays Prevents Overtaxing of Facilities," Hospitals, XLI, No. 1 (January 1, 1967), 87-89; Karl E. Hansen and R. Larry Snider, "Scheduling System Shows Way to Expand X-ray Productivity 30%," The Modern Hospital, CII, No. 4 (April, 1964), 110-12; John G. Steinle, "Time Criteria for the Radiology Department," Hospital Topics, XXXV (December, 1957), 56; Sister Vincent, D.C., "Special Procedures Increase Radiographic Work," Hospital Management, CII (April, 1967), 29-31; E. E. Tillock, "Central Scheduling Smooths the Work Flow," Modern Hospital, CIX (September, 1967), 123-24; "Standard Time Data--Radiology Department," Hospital Topics, XXXV (December, 1957), 70.

<sup>4</sup>R. M. Sigmund, "Survey Shows We Could Cut Costs of Care if We Really Cared To," Modern Hospital, CIX (September, 1967), 108-11.

<sup>5</sup>Victor R. Fuchs, "Medical Costs: Why They Are and What They Are," Modern Hospital, CIX (September, 1967), 104-107.

<sup>6</sup>J. D. Welch and B.A. Noble, Toward a Clearer View--The Organization of Diagnostic X-ray Departments (London: Oxford University Press, 1962).

<sup>7</sup>Robert R. Cadmus, "Efficient Layout of the Radiology Department," Hospitals, XL (May 1, 1966), 68.

layout of X-ray departments for better operation.

Storm,<sup>8</sup> Lambertsen,<sup>9</sup> Orr,<sup>10</sup> High,<sup>11</sup> and Weil<sup>12</sup> discuss various management and administrative matters of concern in the efficient organization and operation of the various subdivisions of the hospital in the provision of health care.

Subjects of general interest that provide background information are not cited here but are included in the bibliography for the benefit of the reader.

#### Computer science

A multitude of articles have appeared in the literature in the last five years concerning advances in computer science that have application in the hospitals of today. Key references in this area are cited on pages 25 and 26 in the discussion of applications that are pertinent to this study.

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<sup>8</sup>William J. Storm, "Surveying the X-ray Department," Hospital Management, XC (November, 1960), 72-75.

<sup>9</sup>Eleanor C. Lambertsen, "Programming for Patient Care: Nursing Service Interpretation," Military Medicine, CXXXI, Part 2 (December, 1966), 14, 96.

<sup>10</sup>Kenneth D. Orr, "Programming for Patient Care: The Hospital Administrator's Interpretation," Military Medicine, CXXXI, Part 2 (February, 1967), 1490-94.

<sup>11</sup>Geoffrey E. High, "Administration and X-ray Service," Hospital Progress, XLVI (May, 1965), 126-44.

<sup>12</sup>Thomas P. Weil and Theodore T. Ott, "Management Aspects of the Department of Radiology," Radiologic Technology, XXXVIII (May, 1966), 320-23 and XXXVIII (November, 1966), 153-56.

CHAPTER II  
DISCUSSION

The Present System

The investigation disclosed that the requirement for generating doctors' orders begins with the admission of a patient to the hospital with a presumptive diagnosis. Few patients have had their diagnostic workup begun in the outpatient clinic prior to admission. Outpatient records, for those patients who have been seen in the outpatient clinic on previous occasions are available, however, on request for ward doctors to review.

Upon arrival on the ward, the patient is assigned to a room and bed and is seen by the ward nurse; and an estimate of the urgency of care is made. If urgent, a doctor is called immediately and emergency workup and care of the patient initiated. Doctors' orders in this type of care are usually given orally and recorded later at an appropriate time. If the case is routine, the nurse initiates a tentative diet order to be certain the patient is fed and notifies the doctor of the presence on the ward of a new patient. Since this initial diet order is a tentative one, to assure the patient having a meal brought up from the Dietary Department, the doctor may change it at a later time because of special studies that are required or because the patient's diagnosis requires a special diet (e.g., a diabetic), (Figure 1).

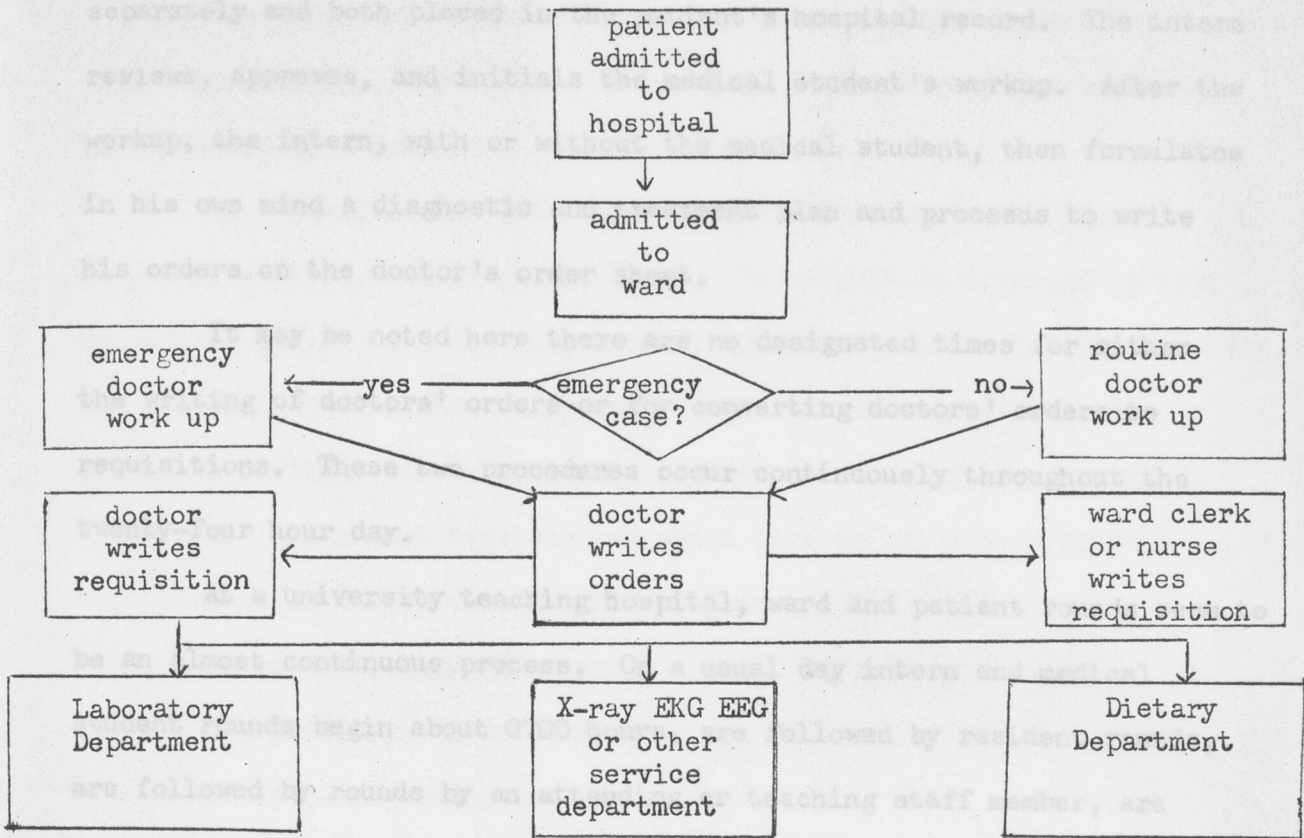


Fig. 1.--Generation and implementation of doctors' orders.

The majority of patients are admitted to the wards between 1000 and 1500 hours each day. A varying number of medical students, interns, and residents are assigned to each service; but these are usually one resident, one intern, and four medical students. Interns are assigned the overall responsibility for diagnosis, care, and management of the patient. Specific responsibility for the writing of all doctors' orders is given to the intern.

Upon notification by the nurse of the presence of a new patient, the intern makes a screening visit as soon as possible to formulate a tentative patient care plan and allocate a specific time and place to do the workup.

At an appropriate time the intern and a medical student do a complete history and physical examination. These two workups are done

separately and both placed in the patient's hospital record. The intern reviews, approves, and initials the medical student's workup. After the workup, the intern, with or without the medical student, then formulates in his own mind a diagnostic and treatment plan and proceeds to write his orders on the doctor's order sheet. These must be arranged by the

request. It may be noted here there are no designated times for either the writing of doctors' orders or for converting doctors' orders to requisitions. These two procedures occur continuously throughout the twenty-four hour day. requisitions which take priority over routine

requis. At a university teaching hospital, ward and patient rounds seem to be an almost continuous process. On a usual day intern and medical student rounds begin about 0700 hours, are followed by resident rounds, are followed by rounds by an attending or teaching staff member, are followed by resident rounds, are followed by evening rounds which may or may not be conducted by an attending staff member. Ward and patient rounds are not as frequent on the surgical services because the surgeons spend a considerable portion of the day in the operating room. During these ward rounds the history, diagnosis, and treatment of each patient is reviewed and additional requirements or requirements no longer indicated are identified. Ward rounds not only produce additional requirements for doctors' orders, which are in due course written on the doctor's order sheet by the intern, but will also generate a need to change requirements that the intern has already scheduled for the patient. requisitions may

be done This need to change requirements already scheduled with the service departments or to intercept a requisition enroute creates a considerable amount of turbulence and dissatisfaction for the personnel of both the nursing unit and the different service departments. ger, in

There are two separate methods by which doctors' orders are converted into requisitions. First there are certain requisitions that can only be initiated by a doctor:

1. Consultations with other services or departments (i.e., surgical, medical, neurological, etc.). These must be arranged by the requesting doctor with the doctor who is going to provide the consultation. The requesting doctor must complete a consultation request on which pertinent portions of the patient's history and findings are recorded.
2. All urgent requisitions which take priority over routine requisitions in the service department concerned.
3. Electroencephalograms.
4. Radiological procedures.
5. Electrocardiograms.
6. Cytology requests.
7. Pathological examination of tissue requests.
8. Blood transfusion requests.

Second, requisitions for all other requirements generated by doctors' orders are transcribed by nursing unit personnel. A charge nurse, one or more licensed practical nurses (LPN), and a ward clerk constitute the nursing unit staff. The overall responsibility for transcribing doctors' orders is that of the charge nurse. The direct responsibility is that of the ward clerk. Depending upon how busy they are at the nursing station, conversion of doctors' orders to requisitions may be done by any of the nursing station staff. It should be noted that the recent addition of a unit manager may, in the future, result in a change or at least a dual responsibility for this portion of the administrative function at the nursing station. The unit manager, in

his role as the administrative supervisor, may take over supervisory responsibility for transcribing doctors' orders and for converting them into requisitions.

Special requisition forms are provided at the nursing station for each service department. Completed requisitions are placed in a pick-up box for pick-up by messengers from central service and carried to the appropriate service department. Urgent requisitions are hand carried to the appropriate service department by ward personnel, or services are requested by telephone.

Once the completed requisitions are delivered to the service department concerned with the study, a work roster is made listing the name of the patient, his ward, and the study requested (Figure 2, p. 18). Because there are no designated pick-up and delivery times for requisitions, they dribble down throughout the day and night. The Laboratory and Dietary Departments will be described separately because they do not require the presence of the patient in the department. At the beginning of the working day, all the other departments using their work roster as a reference, begin calling the various wards for patients (2). If the patient is available (7), the ward is asked to send the patient down for study. Nursing unit personnel call Central Messenger Service for an attendant. An attendant is dispatched to the requesting ward (6), picks up the patient, and takes him to the designated service department (4). When the study is complete, the service department returns the patient to his ward by means of the Central Messenger Service attendant assigned to the service department (2). Emergency cases are sent directly to the service department with a completed requisition following an alerting telephone call (3).

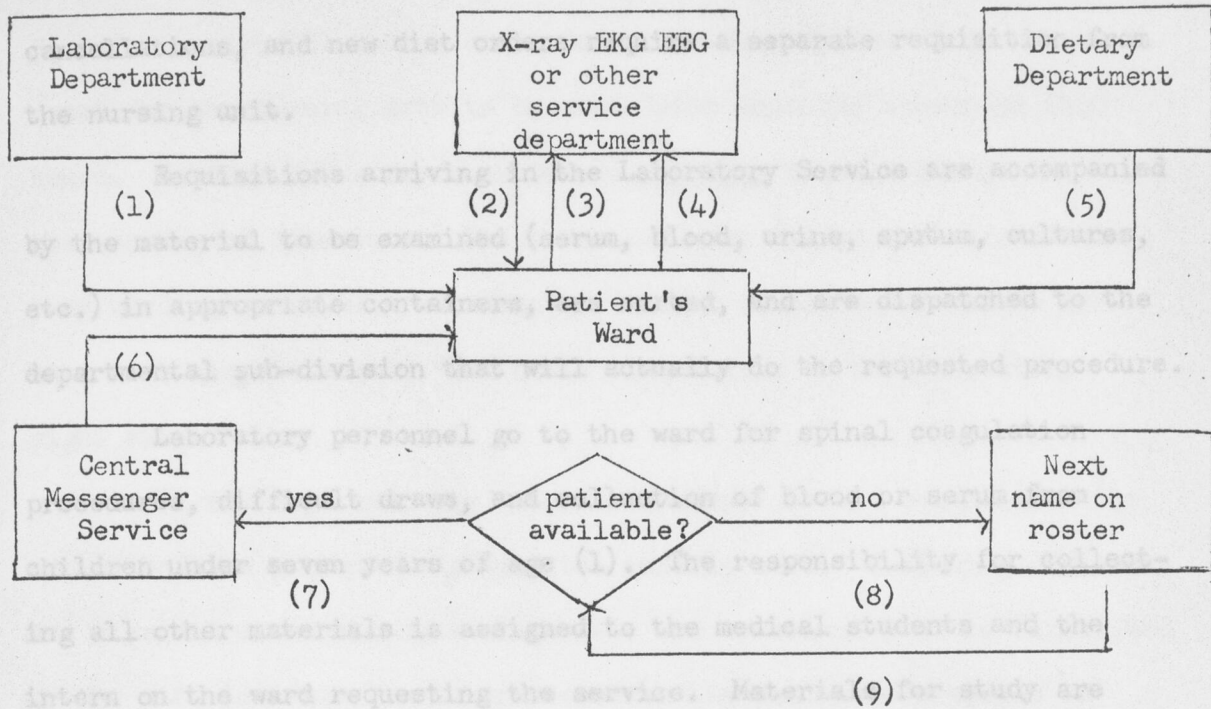


Fig. 2.--Implementation of doctors' orders.

If the patient is not available for study when the service department calls (8), the service department secretary simply calls for the next patient on the roster (9).

Thus one can see that at the beginning and all through the working day service departments are competing with each other to obtain the patient for study. Numberless futile attempts to get the patient to the service departments for study result. Innumerable superfluous telephone calls overload the telephone circuits and overburden the personnel on the ward. This creates a major source of dissatisfaction and interference with the orderly implementation of doctors' orders. Second to the ward nurse, the ward intern is the most harassed individual in the hospital. There are a multitude of requirements placed on an intern: endless rounds and conferences to attend; patient workups; and the complete

responsibility for the entire spectrum of patient diagnosis, care, and treatment. He works in the various clinics, in the operating room, and on the wards and has numerous requirements to check x-rays and other trays, which are delivered to the patient's ward and room in special carts by Dietary Department personnel (5). Hold feedings, diet changes, diet studies either by telephone or by a personal visit to service departments.

cancellations, and new diet orders require a separate requisition from the nursing unit.

Requisitions arriving in the Laboratory Service are accompanied by the material to be examined (serum, blood, urine, sputum, cultures, etc.) in appropriate containers, are sorted, and are dispatched to the departmental sub-division that will actually do the requested procedure.

Laboratory personnel go to the ward for spinal coagulation procedures, difficult draws, and collection of blood or serum from children under seven years of age (1). The responsibility for collecting all other materials is assigned to the medical students and the intern on the ward requesting the service. Materials for study are collected in the following way: based on the requisitions that have accumulated, the night duty nurse prepares the appropriate tubes for blood and containers for other materials, labels them properly, and places the tubes in a rack for the student or intern who is scheduled to draw the morning bloods. After the morning draw, bloods and body fluids are drawn when it is convenient or required of the intern or student. This creates a major source of dissatisfaction and interference with the orderly implementation of doctors' orders. Second to the ward nurse, the ward intern is the most harassed individual in the hospital. There are a multitude of requirements placed on an intern: endless rounds and conferences to attend; patient workups; and the complete responsibility for the entire spectrum of patient diagnosis, care, and treatment. He works in the various clinics, in the operating room, and on the wards and has numerous requirements to check x-rays and other studies either by telephone or by a personal visit to service departments.

He is an individual who is continually on the run, and it is not unusual for the morning draw to be done later than the scheduled 0700 hours. Routine draws may then become priority draws later on in the morning or afternoon. There are not many things that irritate a busy ward nurse as much as having a handful of bloods thrust in her hand with the statement, "Get these bloods down to the laboratory right away."

In review, then, the need for doctors' orders begins with the admission of a patient to a hospital nursing unit. Following a history and physical examination, a diagnostic and treatment plan is formulated by the ward intern. The intern converts his plan into a series of doctors' orders which are implemented through service department requisitions, thereby creating a simultaneous demand by a number of service departments for the patient. These demands take the form of a multitude of telephone calls to the nursing unit in an institution where all patients are brought for study to service departments on an "on call" basis.

The present system seems to cry out for some kind of scheduling system, for some kind of scheduling system that will permit an orderly, logical, and systematic approach to the diagnosis, care, and treatment of patients.

#### Magnitude of the Service Department Workload

Table 1 shows that beginning in FY 1965 there has been a slow but progressive decline in hospital admissions, patient days, and outpatient visits. On the other hand, there has been a gradual increase in the number of procedures performed by the service departments. A significant gain

can be noticed in the four-year period in the number of diagnostic x-ray procedures. The most striking increase, however, is in the number of laboratory procedures that are performed during the year.

TABLE 1

## MAGNITUDE OF THE SERICE DEPARTMENT WORKLOAD

	FY 1965	FY 1966	FY 1967	FY 1968
Hospital admissions	18,616	18,190	17,633	17,300
Patient days	159,956	157,438	155,693	157,140
Outpatient visits	182,837	179,576	179,742	176,175
Electroencephalograms	2,060	2,010	1,882	1,964
Electrocardiograms	15,439	15,918	15,517	18,102
Consultations	10,735	11,744	11,957	12,055
X-ray procedures	47,862	46,461	58,116	57,356
Laboratory procedures	937,907	979,524	1,077,693	1,118,259

Source: Records of the University of Kansas Medical Center.

The gradual increase in the overall workload for the service departments in the face of a decrease in patient population takes on added significance and means that doctors are ordering more and more diagnostic studies for each patient admitted to the hospital.

#### Problems Posed by the Present System

Problems posed for the nursing unit are:

1. Inability to sequentially and efficiently plan a patient's diagnostic and treatment program.
2. Inability to plan the daily ward routines, programs, and work

requirements. during certain periods in the morning and early afternoon.

3. Inability to know with reasonable certainty when a patient will be present on the nursing unit for meals and treatment procedures.
4. Consumption of an excessive amount of nursing time, which could be devoted to nursing duties by superfluous communications.
5. Waste of time and effort of nursing unit personnel by changes in doctors' orders.
6. Production of additional demands on nursing unit personnel by missed and delayed meals.
7. The problem of routine blood studies that suddenly become priority items.
8. Difficulty in maintaining reasonable control of flow of patients to and from the nursing unit under the present system.
9. Frequency of turbulence, congestion, and "snafus!"
10. Delay in reports from the service departments.
11. Excessive time consumed by the present requirement to affix multiple reports to sheets in the patient's chart. (This procedure produces a bulky chart that is difficult to refer to, and requires time-consuming, hand-made laboratory data summaries to recognize trends in a patient who is receiving continuing laboratory determinations).

Problems posed for the Radiology Department, EEG and EKG services are:

1. Inability to predict the workload for the next day makes it impossible to efficiently plan and organize the assignment of technicians and radiologists, accomplish radiological procedures in an orderly way, and expedite the progress of patients through the department.

2. The on-call system produces a high degree of congestion in

the department during certain periods in the morning and early afternoon.

3. The excessive number of telephone calls necessary in the present system produces frequent busy signals and inability to immediately contact a nursing unit to send down a patient.

4. The on call system produces frequent patient nonavailability, which causes problems for the consultative services, the administration, the doctors, and the patient.

a. Consultative services problems are patient nonavailability and superfluous communications.

b. Problems posed for the administration are complaints from patients and personnel of the staff, increased personnel turnover because of dissatisfaction, and increased hospital cost of operation because of longer patient stay.

c. Problems for the doctors include delay in completing the patient's diagnostic workup; delayed diagnostic reports; and patient nonavailability for ward rounds, treatment, and consultations.

d. The patients' problems are increased waiting time, increased charges because of longer hospitalization, and missed and delayed meals.

#### Alternatives and Issues

The problem statement has two components: the generation of doctors' orders and the implementation of doctors' orders. Certain issues can be identified and dealt with in the first component; alternative solutions can be selected and considered in the second component which seems to comprise the major portion of the problem that can be pragmatically dealt with effectively. Each will be considered separately.

The generation of doctors' orders

Some of the reasons why the staffs of university teaching hospitals generally and the University of Kansas Medical Center specifically generate a larger number of doctors' orders than non-teaching hospitals have been cited in the introductory portion of this paper. They center around the special teaching mission of the hospital, the special problems involved with young doctors who are just beginning their medical careers, the exhaustive diagnostic needs of the "problem" case, the teaching techniques of an occasional staff member, and the fact that an academic environment lends itself more to the teaching objective than economic considerations.

One may ask, then, why limit the diagnostic horizon of the teaching professor and his neophytic retinue? Is not the Aristotelean cause of learning being served? Is not the patient getting the ultimate and finest medical care the state of Kansas can produce? Can you equate cost with life, death, and illness? Such questions cause us to pause and reconsider the objectives of this great medical institution: "Teaching was the founding stone of the Medical Center. . . it remains the institution's primary guiding force."<sup>1</sup>

In this era of technological advances in computer science,<sup>2</sup>

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<sup>1</sup>Office of Informational Services, Facts and Figures about the University of Kansas Medical Center (Kansas City: University of Kansas Medical Center, March 1, 1968), p. 1.

<sup>2</sup>John M. Buchanon, "Automated Hospital Information Systems," Military Medicine, CXXXI, Part 2 (December, 1966), 1510-12; Baldwin G. Lamson, et al., "A Hospital Wide System for Handling Medical Data," Hospitals, XLI (May 1, 1967), 67-80; Bob Potter, "Doctor-Computer Dialogue Speeds Order," Modern Hospital, CIX, No. 1 (July, 1967), 102.

multichannel autoanalyzers,<sup>3</sup> automated multitest laboratories,<sup>4</sup> computerized laboratory information retrieval systems,<sup>5</sup> multiphasic computerized diagnostic health screening centers,<sup>6</sup> and computer recording and interpretation of X-ray films and electrocardiograms,<sup>7</sup> one can recognize that the day has arrived in which there is no limit to the diagnostic services that can be provided at a fraction of the previous cost. Lindberg<sup>8</sup> has pointed out that in a system employing electronic data processing equipment programmed to accept and distribute multiple results, it is economically possible to deliver a number of test results for little more

<sup>3</sup>Violette Bortsch, "Linking Analyzer With Computer Speeds Reporting of Lab Results," Hospital Topics, XLV (October, 1967), 71-74; M.M. Patton, "Automated Multichannel Laboratory Procedures," Bulletin of the College of American Pathologists, XXI (October, 1967), 331-32.

<sup>4</sup>L.G. Whitby, "Automation in Clinical Chemistry: A Consideration of Cost Implications," Hospital (London), LXIII (March, 1967), 89-94; G. Z. Williams, "Laboratory Automation Systems," Bulletin of the College of American Pathologists, XXI (December, 1967), 383-87.

<sup>5</sup>C.R. Youngquist, "Computer Speeds Reporting of Laboratory Test Results," Hospitals, XLII (January 1, 1968), 37-39.

<sup>6</sup>Morris F. Collen, "Multitest Laboratory in Health Care of the Future: Kaiser Foundation Hospital, Oakland, California," Hospitals, XLI (May 1, 1967), 119-24; W. Slack, et al., "A Computer-Based Physical Examination System," Journal of the American Medical Association, CC, No. 3 (April 17, 1967), 224-28; D.A. Lindberg, et al., "Computer Sets Stage for Multi-Testing," Modern Hospital, CVIII, No. 4 (April, 1967), 128-30.

<sup>7</sup>"A Promising Use for the Computer: Interpretation of X-rays," New York State Journal of Medicine, LXVII (September 15, 1967), 2439; "Computer Provides 'Instant' ECG Diagnosis," Medical World News, VIII (April 14, 1967), 100-105; L. Porady, "Computer Analysis of the Electrocardiograms: A Joint Project," Journal of the Mount Sinai Hospital of New York, XXXIV (January-February, 1967), 69-88; J.R. Whiteman, et al., "Automation of Electrocardiographic Diagnostic Criteria," Journal of the American Medical Association, CC, No. 11 (June, 1967), 932-38.

<sup>8</sup>D.A. Lindberg, et al., "Computer Sets Stage for Multi-Testing," Modern Hospital, CVIII, No. 4 (April, 1967), 128-30.

cost than formerly involved in producing the result of a single determination.

The subject of unnecessary laboratory and other diagnostic studies comes up from time to time in military as well as civilian hospitals. Perhaps technology will solve this problem for us in the near future. Perhaps doctors are not ordering enough studies for optimum diagnosis and treatment!

A detailed consideration of the "pro's and con's" concerning the diagnostic indications for diagnostic studies and the economic impact of unnecessary studies is cited below.<sup>9</sup>

The teaching staff at the University of Kansas Medical Center recognizes the probability that unnecessary requirements are placed on the service departments and feels that economic considerations in this and many other areas must be emphasized in the curriculum of the medical school and followed up in the post-graduate period of training in the hospital. The assistant chairman of a major department confided that he is currently emphasizing diagnostic indication for procedures ordered when he makes his daily rounds. He felt that the problem for the Center may be solved shortly by advances in technology, but pointed out that the majority of his young doctors will be going into practice in areas where economic necessity is paramount.

For the reasons cited in Chapter I, pages 2, 3, and 4, and summarized above, any attempt to alter the present system of generating doctor's orders would immediately incite the resistance and hostility of the teaching staff because of the interference that would result in the

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<sup>9</sup>"Routine Tests--The Physician's Responsibility," New England Journal of Medicine, CCLXXIV (January 27, 1966), 222 and CCLXXV (July 7, 1966), 56.

<sup>14</sup>"Order in the X-ray Department," Hospitals and Health Management, XXV (October, 1962), 923-24.

traditional right of physicians to determine what is needed for their patients and the ability of the faculty to accomplish their primary teaching mission. "Teaching was the founding stone of the institution . . . it remains the institution's primary guiding force."<sup>10</sup>

The implementation of doctors' orders

In view of the material presented and the current literature, it would appear that a system of scheduling all the requirements that are generated by doctors' orders would come closest to solving the problem posed in this study.

Tillock<sup>11</sup> has pointed out the advantages of a centralized scheduling system in solving the problems experienced at his hospital. Hansen and Snider<sup>12</sup> have written of their scheduling system which has promoted better organization of the workload, efficiency, and lower costs. Welch, in his comprehensive book on management aspects of X-ray departments states, "A system of appointments will do much to dispel the unfortunate belief that X-ray departments are places where patients must be resigned to wait."<sup>13</sup> A recent editorial puts it this way, "The crux of the matter is the organization of the workload and the work made subject to the control of an appointment system."<sup>14</sup>

Under the present system, for instance, nurse Jones thinks in

<sup>10</sup>Facts and Figures about the University of Kansas Medical Center, p. 4.

<sup>11</sup>E.E. Tillock, "Central Scheduling Smooths the Work Flow," Modern Hospital, CIX (September, 1967), 123-24.

<sup>12</sup>Karl E. Hansen and R. Larry Snider, "Scheduling System Shows Way to Expand X-ray Productivity 30%," The Modern Hospital, CII, No. 4 (April, 1964), 110-12.

<sup>13</sup>J.D. Welch and D. Noble, Towards a Clearer View--The Organization of Diagnostic X-ray Departments (London: Oxford University Press, 1962), p. 26.

<sup>14</sup>"Order in the X-ray Department," Hospitals and Health Management, XXV (October, 1962), 923-24.

terms of a barium enema for patient Smith tomorrow morning. Under a scheduling system she would be thinking: "Patient Smith has a barium enema scheduled at 1000 hours, which gives me time to get his blood chemistries drawn at 0700 hours, followed by his fasting blood sugar; and maybe I can get him down for his EKG before he has to go to X-ray." In the former on-call system, she could have had the chemistries drawn but would have been reluctant to send the patient to EKG or begin the fasting blood sugar in view of the patient's on-call status for X-ray. At the University of Kansas Medical Center, nurses gave precedence to the radiology department because of the time involved, the importance of X-ray studies, and the requirement to prepare the patient with castor oil or enemas the night before.

This brief example demonstrates how a scheduling system permits planning of the patient's workup and how several procedures can be done during a period in which only one or two are possible under the present system.

If scheduling is expanded to include everything that is ordered for a patient, then all departments start thinking in terms of specific times of the day instead of just "tomorrow." Such a system permits each nursing unit, service, department, and division to organize their daily workload in such a way as to get maximum utilization of their medical resources.

Two systems of scheduling that might be implemented and accomplished at the University of Kansas Medical Center: a centralized, computer programmed scheduling system and a decentralized, departmental scheduling system. Certain elements of information are necessary in the design of either system. These elements that must be known are:

1. The number and type of studies requested.
2. The time needed to perform the study.
3. The number of equipment/room units available for the study.
4. The number of specially trained personnel available to work the equipment/room units.
5. The total time available each day to do the studies.

All requests for studies (requisitions) must arrive in the scheduling office the day prior to the study requested and sufficiently early to allow the schedule to be made and the copies returned to the requesting unit.

Based on Centralized, computer programmed scheduling system.---In this system the information listed above for each service department is programmed into the computer. Requisitions for procedures resulting from doctors' orders are delivered by messenger to a central scheduling office. Requisition data (patient's hospital number, name, ward, study requested, etc.) is converted to punched cards by card punch operators and fed into the computer at a pre-determined time each day. By comparing preprogrammed service department information with daily patient data, the computer is able to produce a print-out schedule of the next day's work for each service department and each requesting nursing unit. Requirements generated by the outpatient department could be added if desired.

Flexibility is added to the system by programming into the computer experience data concerning time required in each service department to take care of "stats" (emergencies) and priority "drop-ins."

With the schedules produced by the computer, all nursing units and service departments can proceed with planning the work for the next day.

Decentralized, departmental scheduling system.---In this system,

the ward nurse and her administrative personnel take the place of the computer. As requirements are generated by doctors' orders and converted to requisitions, priorities must be established for each patient's workup. In the example cited previously of patient Smith, the nurse might specify blood chemistry, fasting blood sugar, barium enema, and EKG. The ward clerk would then set the patient up for an 0700 blood draw by the medical student, plan a fasting blood sugar test by the ward intern, call X-ray for a mid-morning appointment for barium enema (requisition to follow), and fit the patient in for his EKG at an appropriate and specific time. Based on the scheduling information she now has, the ward clerk can make out a specific diet requisition for the next day's noon feeding for patient Smith at the specific time estimated for his return from the X-ray department. If the fasting blood sugar had not been ordered and a surgical consultation requested instead, the ward clerk could have specified an earlier appointment for the barium enema, scheduled the EKG to follow, and requested a surgical consultation for the afternoon.

Plans are complete and priority established for automating the management and reporting of laboratory data. The computer technicians and director of the automatic data processing system at the University of Kansas Medical Center have pointed out to the investigator that little additional effort would be required to add the management and reporting of data and reports for other service departments. They point out the following benefits of this addition to the system:

1. More timely reports would result because the computer would provide an updated patient daily summary, an updated service department work log, and more rapid reporting to wards during the day.
2. More accurate reports would be forthcoming because of automatic

checking of laboratory data for accuracy and the elimination of manual transcription of reports to a patient summary.

3. Manual effort required would be reduced because the computer would prepare daily work lists, labels, and prepare the daily patient summary report.

4. A machine record of service department results would be built for future patient care information, for subsequent admissions, and for use in teaching and research studies.

### Comparison of Alternative Courses of Action

Three alternative courses of action can now be considered:

1. Continue the present system.
2. Institute a centralized, computer programmed scheduling system.
3. Institute a decentralized, departmental scheduling system.

Each will be compared and tested against the criteria established for the study and with each other. Each alternative course of action continues in effect the present system of generating doctors' orders unchanged for reasons cited on page 26.

#### Continue the present system

Advantages.--No retraining, reeducation, or change would be necessary. The present system has been successful in the past in accomplishing the Center's mission and is likely to do so in the future.

Disadvantages.--The present system meets none of the criteria established for the study. All of the problems posed by the present system listed previously are characteristic of the present system.

Institute a centralized, computer programmed scheduling system

Advantages.--1. With a computer prepared schedule of the workload for the following day, service departments would be able to plan their work in a systematic, orderly, and efficient way by taking into account absences of technicians, repairs to equipment, additions to equipment, and the many other variables of day to day operation.

2. Nursing units could similarly plan and organize their own work and the workup of their patients.

3. The time the patient is absent from the nursing unit and therefore unavailable for ward rounds, treatment, and other studies, would be minimized because of better control of the flow of patients to and from the service departments.

4. The time required to workup, diagnose, and treat the patient would be reduced because more procedures could be accomplished in any given day than under the present system. Length of hospital stay would thereby be reduced and hospital costs and patient charges lowered.

5. By abolishing the "on call" system superfluous telephone calls would be reduced. This reduction and the opportunity to organize the ward workload would tend to minimize the time the nurse has to devote to duties other than nursing, patient care, and management.

6. Systematic scheduling would result in a change from the present system of transcribing doctors' orders on a continuous basis by ward personnel to a system in which doctors' orders would be transcribed at specific times such as 0900 hours, 1300 hours, and 1800 hours. This modification would allow a period for doctors' orders to accumulate and changes in doctors' orders to be made before the requirements are converted into requisitions and scheduled. This modification would minimize the

number of changes and additions to doctors' orders and would reduce the time the ward nurse spends in non-nursing endeavors.

7. The scheduling system would provide a means for the nursing unit personnel to know at all times the location and probable time of return of a patient to the nursing unit and would reduce to a minimum the number of missed or delayed patient meals and appointments.

8. The system under discussion, because of better control and more efficient management, would reduce congestion of patients enroute to, present in, and returning from the service departments and, at the same time, reduce patient waiting time prior to and following diagnostic procedures.

9. The addition of computer management and reports from service departments would assure attainment of the last of the criteria established for the study, which is to reduce to a minimum the time required to get the report of a diagnostic study back to the doctor.

10. Finally, the centralized scheduling system helps to solve all the problems posed in the present system except the routine morning blood draws by the harassed intern. Even here, it is conceivable that the time saved by a well-organized system might assist in eliminating even with this problem.

Disadvantages.--1. The transition period from the present system to the centralized scheduling system would probably border on the chaotic for that period of time necessary for all to become familiar with the new system.

2. A great deal of effort on the part of the entire staff would be required since, during the transition period, parallel systems would be necessary for the benefit of the patients.

3. Equipment for such a system is expensive, and additional components will be required to fully implement the program.

5. This scheduling system would provide a means of control of

4. A significant re-training and re-education program would be required.

In summary, the centralized, computer programmed scheduling system reinforced with a system of computer management and data reporting satisfies all the criteria for the study established in the beginning. The system also solves or partially solves all the problems posed by the present system. The disadvantages of the system have been pointed out. The administrative executives of the University of Kansas Medical Center informed the investigator that the additional equipment required can be acquired within six to twelve months, and the automatic data processing specialists have stated that the system is feasible, practical, and can be implemented and accomplished. All echelons of the administrative and professional staff recognize the need and the advantages of such a system.

Institute a decentralized, departmental scheduling system

Advantages.--1. This system also provides a means for planning the patient's diagnostic and treatment program in advance, so as to obtain maximum utilization of medical resources.

2. Service departments would be able to plan their work in a systematic, orderly, and efficient manner, thereby reducing patient waiting time and congestion.

3. The time required to workup, diagnose, and treat the patient would be reduced and length of hospital stay shortened for reasons similar to those cited above.

4. Systematic scheduling would satisfy the criteria established concerning minimizing changes and additions to doctors' orders for reasons similar to those cited for the centralized system.

5. This scheduling system would provide a means of control of

patient flow and late or missed meals and would enable the nurse to know the location and probable time of return of the patient to the nursing unit.

6. The system would enable the nursing unit personnel to organize and plan their work in a more efficient way and permit the nurse more freedom from harassment by unprogrammed requirements that interfere with her primary mission.

7. The system solves the problem of manual processing of multiple reports (they are affixed to the charts) and does away with the need for manual laboratory data summaries to recognize trends in a patient who is receiving continuing laboratory examinations.

Disadvantages.--1. The decentralized system does not completely satisfy the criterion of minimizing the number of telephone calls required to accomplish the patient's diagnostic workup because the nursing unit personnel have to substitute for the computer and have to coordinate requirements for service department by telephone.

2. This system does not reduce to a minimum the time required to get the report of a diagnostic study to the doctor for better patient care.

3. The decentralized system does not remove the scheduling burden from the shoulders of the nursing unit personnel and thereby interferes with their primary patient care mission.

In summary, the decentralized, departmental scheduling system does meet most of the criteria established in the beginning for the study and also solves most of the problems posed by the present system. It does not, however, satisfy all the criteria, nor does it solve all the problems of the present system. The system can be initiated without delay and without the requirement for expensive additional components for the automatic data processing system. The greatest advantages would appear to be that

it would go a long way toward solving the overall problem, could be implemented immediately, and would function as an excellent means of easing the transition phase to the fully centralized system.

established at the beginning of the study.

#### Summary

Three alternative courses of action were recognized in dealing with the problem. Faced with an increasing service department workload produced by doctors' orders in spite of a decrease in patient population, the administrative executives of the University of Kansas Medical Center

recognized the need for an objective analysis of the present system of generating and implementing doctors' orders by an outside doctor-observer.

This analysis was accomplished by this investigator and produced the following observations:

1. The present system of generating doctors' orders is based on the primary objectives of the institution and is not amenable to change.

2. The present system of implementing doctors' orders is based on an on-call system which gives rise to multiple problems:

a. Inability to sequentially and efficiently plan a patient's diagnostic and treatment program on the nursing unit and in the service departments in an orderly and organized manner.

b. Superfluous communications and changes in doctors' orders consume an excessive amount of nursing unit personnel time which can be more profitably devoted to patient care and management.

c. Inability to control the flow of patients and to predict their availability for required studies either on the ward or in the service department.

d. Missed and delayed meals and increased patient waiting time are characteristic of the present system.

e. Reports from service departments are delayed and require time-consuming manual management by the personnel nursing unit.

Essential criteria for satisfactory solution of the problem were established at the beginning of the study.

Three alternative courses of action were recognized in dealing with the problem:

1. Continue the present system.
2. Institute a centralized, computer programmed scheduling system.
3. Institute a decentralized, departmental scheduling system.

These three alternative courses of action were compared with the criteria established for the study and with each other. The first alternative satisfies none of the criteria for a satisfactory solution to the problem and suffers from all the problems previously cited. The second alternative satisfies all of the criteria for a satisfactory solution to the problem and solves all the problems posed by the present system.

The third alternative satisfies most, but not all, of the criteria for a satisfactory solution to the problem and solves most, but not all, of the problems posed by the present system. It suffers none of the disadvantages of the second alternative and can be implemented without delay and without the requirement for purchase of additional expensive equipment. In addition, institution of this alternative would serve as an excellent means of easing the transition to the system envisioned in the second alternative.

the interim system to a centralized, computer programmed scheduling system incorporating a system of computer reporting and management of the data resulting from service department studies.

## CHAPTER III

### CONCLUSIONS AND RECOMMENDATIONS

#### Conclusions

The most efficient system of generating doctors' orders at the University of Kansas Medical Center is the present system.

The most efficient system of implementing doctors' orders at the University of Kansas Medical Center is a centralized, computer programmed scheduling system reinforced with a system of computer reporting and management of the data resulting from service department studies.

#### Recommendations

1. Retain the present system of generating doctors' orders.
2. Emphasize the economic aspects of medical practice in the medical school curriculum and during the postgraduate educational period.
3. Implement as soon as possible a decentralized, departmental scheduling system as an interim solution to the problems of the present system and in order to smooth the period of transition to the centralized, computer programmed scheduling system.
4. Implement the necessary studies and action required to convert the interim system to a centralized, computer programmed scheduling system incorporating a system of computer reporting and management of the data resulting from service department studies.

## APPENDIX

### A SCHEDULING SYSTEM FOR THE RADIOLOGY DEPARTMENT

The radiology department of the University of Kansas Medical Center does most of its work between 0700 and 1830 hours, five days a week. Procedures requiring fluoroscopy are done by two of the four radiologists on an alternating basis during the morning period. Twenty fluoroscopies are considered a normal load for the department. The daily workload runs about one hundred-fifty procedures each week-day.

## APPENDIX

### A SCHEDULING SYSTEM FOR THE RADIOLOGY DEPARTMENT

There are two rooms equipped for special procedures, two for fluoroscopies, one for dental and bone density, and three for general X-ray films. The department is staffed to provide one X-ray technician and one student for each room. There is one senior technician in charge who assists and coordinates technical and administrative aspects of the department and one individual who is responsible for calling patients from the nursing units to the department and coordinating the processing of patients during their time in the department.

In order to develop a successful scheduling system that equates departmental capacity to the demand for X-ray procedures, it was necessary to determine the length of time that each type of X-ray procedure took to accomplish. Of interest, but not pertinent to scheduling, was a determination of the length of time patients were waiting before and after their X-ray procedures were performed. This was accomplished in the following way: Patients were logged into the department and time recorded of their

time of arrival, the time they entered the diagnostic room, the time they left the diagnostic room, and the time they left the X-ray department.

A frequency distribution of the recorded results of waiting times for two hundred-seventy-six patients. It was found that 28% of the patients were having to wait over twenty minutes before their

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Procedures requiring fluoroscopy are done by two of the four radiologists on an alternating basis during the morning period. Twenty fluoroscopies are considered a normal load for the department. The daily workload runs about one hundred-fifty procedures each week-day.

There are two rooms equipped for special procedures, two for the fluoroscopies, one for head and neck films, and three for general X-ray films. The department is staffed to provide one X-ray technician and one student for each room. There is one senior technician in charge who assists and coordinates technical and administrative aspects of the department and one individual who is responsible for calling patients from the nursing units to the department and coordinating the processing of patients during their time in the department.

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A frequency distribution was made of the recorded results of waiting times for two hundred-seventy-six patients. It was found that 28% of the patients were having to wait over twenty minutes before their diagnostic procedure was begun and 13% were having to wait over thirty minutes.

A frequency distribution was made of the recorded times that each patient occupied the diagnostic room for each type of procedure and the ninety percentile range determined. This ninety percentile range was arbitrarily chosen as the standard time that each procedure would usually require. Three hundred-forty-six procedures provided the basis for the above determination.

Four radiologists and four X-ray technicians were asked to submit an estimate of the diagnostic time required to perform the procedures considered in the study and in every case were reasonably close to the computed times. The results are as follows:

Upper GI Series	30 minutes
Barium Enema	45
Gallbladder Series	15
IV Pyelogram	45
KUB	20
IV Cholangiogram	30
Chest X-ray	10
Chest Fluoroscopy or Laminography	30
Spine	20
Sinuses	20
Skull	20
Pelvis	20
Upper Extremity Film	15
Lower Extremity Film	15

It must be emphasized that the standard times arrived at and listed above were based on a small series of cases and will undoubtedly require

some revision as experience factors are accumulated. They are considered to be reliable enough for initiating the scheduling program.

The capacity of the department is determined after the manner of Kanon.<sup>1</sup> The workday is divided into three shifts: the morning shift (0700-1130 hours), the lunch shift (1130-1230 hours), and the afternoon shift (1230-1630 hours). The chief X-ray technician is able to give the scheduling secretary the number of diagnostic rooms he will have available to do the different types of procedures and the number of technicians he will have on duty to work the diagnostic rooms for each shift.

With the information presented above for reference, the scheduling secretary can proceed to make up a master schedule from the requisitions that have come down from the nursing units and other sources. She is able to schedule patients by name and procedure to the appropriate rooms for the time required for the particular study.

Kanon<sup>2</sup> has described at length the details of his successful system in the reference cited. The general principles that he portrays are applicable to centralized departmental scheduling for any of the service departments of the University of Kansas Medical Center.

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<sup>1</sup>Dov Kanon, "Scheduling System for X-rays Prevents Overtaxing of Facilities," Hospitals, XLI, No. 1 (January 1, 1967), 87-89.

<sup>2</sup>Ibid.

## BIBLIOGRAPHY

- "Admission Officer Asks, 'What Would You Like To Eat?' as well as, 'How Are You Going To Pay?'" Hospitals, XI (March, 1966), 81-82.
- Bortsch, Violetta. "Linking Analyzer With Computer Speeds Reporting of Lab Results." Hospital Progress, XLV (October, 1967), 71-74.
- Buchanan, John W. "Automated Hospital Information Systems." Military Medicine, CXXXI, Part 2 (December, 1966), 1510-12.
- Cadmus, Robert E. "Efficient Layout of the Radiology Department." Hospitals, XI (May 1, 1966), 68.
- Collen, Morris F. "Multitest Laboratory in Health Care of the Future: Kaiser Foundation Hospital, Oakland, California." Hospitals, XII (May 1, 1967), 119-21.
- "Computer Provides 'Instant' BIBLIOGRAPHY." Medical World News, VIII (April 22, 1967), 100-5.
- "Doctors Will Order Medication With Light Pen in New Computer System." Modern Hospital, CVIII, No. 2 (February, 1967), 74-76.
- Dunlap, Henry B., Bohls, Dale, and Wiese, Charles A. "They Write It Here, It Comes Out There." Modern Hospital, CLX, No. 3 (July, 1967), 100.
- Fuchs, Victor R. "Medical Coses: Why They Are and What They Are." Modern Hospital, CLX (September, 1967), 104-7.
- Hansen, Karl B., and Snider, Larry R. "Scheduling System Shows Way to Expand X-ray Productivity 30%." The Modern Hospital, CLII, No. 4 (April, 1964), 110-12.
- Hugh, E. Geoffrey. "Administration and X-ray Services." Hospital Progress, XLVI (May, 1965), 126-44.
- Kanon, Dev. "Scheduling System for X-rays Prevents Overtaking of Facilities." Hospitals, XII, No. 1 (January 1, 1967), 87-89.
- Lambertsen, Eleanor C. "Programming for Patient Care: Nursing Service Interpretation." Military Medicine, CXXXI, Part 2 (December, 1966), 1495-98.
- Lansen, Baldwin G., et al. "A Hospital Wide System for Handling Medical Data." Hospitals, XII (May 1, 1967), 67-80.

Lindberg, D.A.B., et al. "Computer Sets Stage for Multi-Testing." Modern Hospital, CVIII, No. 2 (April, 1967), 128-30.

"Management Aspects of the Department of Radiology." Radiologic Technology, XXVIII (May, 1966), 320-23 and (November, 1966), 153-56.

Nelson, Roger B. "Shift Management System Established; Employees Enthusiastic About System." Hospital Progress, XLV, No. 1 (July, 1966), 67-73.

## BIBLIOGRAPHY

"Admission Officer Asks, 'What Would You Like To Eat?' as well as, 'How Are You Going To Pay?'" Hospitals, XL (March, 1966), 81-82.

Bortsch, Violette. "Linking Analyzer With Computer Speeds Reporting of Lab Results." Hospital Topics, XLV (October, 1967), 71-74.

Buchanon, John M. "Automated Hospital Information Systems." Military Medicine, CXXXI, Part 2 (December, 1966), 1510-12.

Cadmus, Robert R. "Efficient Layout of the Radiology Department." Hospitals, XL (May 1, 1966), 68.

Collen, Morris F. "Multitest Laboratory in Health Care of the Future: Kaiser Foundation Hospital, Oakland, California." Hospitals, XLI (May 1, 1967), 119-24.

"Computer Provides 'Instant' ECG Diagnosis." Medical World News, VIII (April 14, 1967), 100-5.

"Doctors Will Order Medication With Light Pen in New Computer System." Modern Hospital, CVIII, No. 2 (February, 1967), 74-78.

Dunlap, Henry B.; Bohls, Dale.; and Wiese, Charles A. "They Write It Here, It Comes Out There." Modern Hospital, CIX, No. 1 (July, 1967), 100.

Fuchs, Victor R. "Medical Costs: Why They Are and What They Are." Modern Hospital, CIX (September, 1967), 104-7.

Hansen, Karl E., and Snider, Larry R. "Scheduling System Shows Way to Expand X-ray Productivity 30%." The Modern Hospital, CII, No. 4 (April, 1964), 110-12.

High, E. Geoffrey. "Administration and X-ray Service." Hospital Progress, XLVI (May, 1965), 126-44.

Kanon, Dov. "Scheduling System for X-rays Prevents Overtaxing of Facilities." Hospitals, XLI, No. 1 (January 1, 1967), 87-89.

Lambertsen, Eleanor C. "Programming for Patient Care: Nursing Service Interpretation." Military Medicine, CXXXI, Part 2 (December, 1966), 1495-98.

Lamson, Baldwin G., et al. "A Hospital Wide System for Handling Medical Data." Hospitals, XLI (May 1, 1967), 67-80.

- Lindberg, D.A.B., et al. "Computer Sets Stage for Multi-Testing." Modern Hospital, CVIII, No. 4 (April, 1967), 128-30.
- "Management Aspects of the Department of Radiology." Radiologic Technology, XXXVIII (May, 1966), 320-23 and (November, 1966), 153-56.
- Nelson, Roger B. "Unit Management Well Established; Employees Enthusiastic About System." Hospital Topics, XLIV, No. 1 (July, 1966), 67-73.
- Office of Informational Services. Facts and Figures About the University of Kansas Medical Center. Kansas City: University of Kansas Medical Center, March 1, 1968.
- "Order in the X-ray Department." Hospital and Health Management, XXV (October, 1962), 923-24.
- Orr, Kenneth D. "Programming for Patient Care: The Hospital Administrator's Interpretation." Military Medicine, CXXXI, Part 2 (February, 1967), 1490-94.
- Patton, M.M. "Automated Multichannel Laboratory Procedures." Bulletin of the College of American Pathologists, XXI (October, 1967), 331-33.
- Pordy, L. "Computer Analysis of the Electrocardiogram: A Joint Project." Journal of the Mount Sinai Hospital of New York, XXXIV (January-February, 1967), 69-88.
- Potter, Bob. "Doctor-Computer Dialogue Speeds Order." Modern Hospital, CIX, No. 1 (July, 1967), 102.
- "A Promising Use for the Computer: Interpretation of X-rays." New York State Journal of Medicine, LXVII (September 15, 1967), 2439.
- Robertson, I. "Survey of Practicing Physicians Regarding Laboratory Procedures." Bulletin of the College of American Pathologists, XX (January, 1966), 7-10.
- Rourke, Anthony J.J. "Some Idiosyncracies of Doctors Cost Hospitals Time and Money." Modern Hospital, CVII, No. 3 (September, 1966), 138.
- "Routine Tests--The Physician's Responsibility." New England Journal of Medicine, CCLXXIV (January 27, 1966), 222 and CCLXXV (July 7, 1966), 56.
- Sigmund, R.M. "Survey Shows We Could Cut Costs of Care If We Really Cared To." Modern Hospital, CIX (September, 1967), 108-11.
- Sister Mary Virginia. "Transmitting Physicians Orders With an Automated Writing Device." American Journal of Hospital Pharmacy, XXII (August, 1965), 464-67.
- Sister Vincent, D.C. "Special Procedures Increase Radiographic Work." Hospital Management, CII (April, 1967), 29-31.

- Slack, W., et al. "A Computer-Based Physical Examination System." Journal of the American Medical Association, CC, No. 3 (April 17, 1967), 224-28.
- "Standard Time Data--Radiology Department." Hospital Topics, XXXV (December, 1957), 70.
- Steinle, John G. "Consultant's Corner." Hospital Topics, XXXXIII (April, 1965), 56.
- Storm, William J. "Surveying the X-ray Department." Hospital Management, XC (November, 1960), 72-75.
- Tillock, E.E. "Central Scheduling Smooths the Work Flow." Modern Hospital, CIX (September, 1967), 123-34. ✓
- Trites, David K., and Schwartau, Neal W. "The Physician's Order--Where, What and How." American Journal of Hospital Pharmacy, XXIV (February, 1967), 69-73.
- Villegos, Eduardo L. "Outpatient Appointment System Saves Time for Patients and Doctors." Hospitals, XLI, No. 8 (April, 1967), 74-78.
- Weil, Thomas P., and Ott, Theodore T. "Management Aspects of the Department of Radiology." Radiologic Technology, XXXVIII (May, 1966), 320-23, and XXXVIII (November, 1966), 153-56.
- Welch, J.D., and Noble, B.A. Toward a Clearer View--The Organization of Diagnostic X-ray Departments. London: Oxford University Press, 1962.
- Whitby, L.G. "Automation in Clinical Chemistry: A Consideration of Cost Implications." Hospitals (London), LXIII (March, 1967), 89-84.
- Whiteman, J.R., et al. "Automation of Electrocardiographic Diagnostic Criteria." Journal of the American Medical Association, CC, No. 11 (June 12, 1967), 932-38.
- Williams, G. Z. "Laboratory Automation Systems." Bulletin of the College of American Pathologists, XXX (December, 1967), 383-87.
- Youngquist, C.R. "Computer Speeds Reporting of Laboratory Test Results." Hospitals, XLII (January 1, 1968), 37-39.

A STUDY TO DETERMINE THE MOST EFFICIENT SYSTEM OF  
GENERATING AND IMPLEMENTING DOCTORS' ORDERS AT  
THE UNIVERSITY OF KANSAS MEDICAL CENTER

COL Charles C. Eaves

46 Pages August, 1969

ABSTRACT

The problem posed by this study was to determine the most efficient system of generating and implementing doctors' orders at the University of Kansas Medical Center.

The problem was studied by conducting an investigation of approximately three weeks duration at the University of Kansas Medical Center. During the study an analysis of the present system of generating and implementing doctors' orders was made, problems posed by the present system determined, and alternative solutions to the problem identified.

It was found that the present system of generating doctors' orders served the objectives of the institution in the best way. The present system of implementing doctors' orders, however, posed a multitude of problems for the patient, the medical staff, and the administration that could be solved by instituting a centralized, computer programmed scheduling system incorporating a system of computer reporting and management of the data resulting from service department studies.

It was recommended that a decentralized, departmental scheduling system be instituted as soon as possible as an interim solution to the problem and to ease the transition period necessary for implementation of the complete centralized system.

A decentralized, departmental scheduling system for the diagnostic X-ray Department was included as a pattern for use in the other service departments.