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A STUDY OF THE RADIOLOGIST STAFFING LEVEL OF DOUGLAS COUNTY HOSPITAL, OMAHA, NEBRASKA

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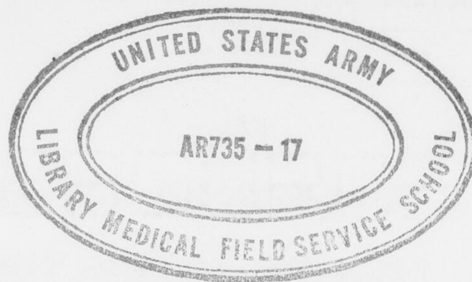

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CHAPTER I

INTRODUCTION

General Information

The department of radiology in a hospital exists for the benefit of sick and injured persons in that hospital. The proper staffing of radiologists in the department is one of the most difficult problems facing the hospital administrator. Regardless of what department to which a physician refers patients in a hospital, adequate staffing is necessary to serve the greatest number of patients possible at the time the service is desired or needed. Ideally, this should be done with a minimal amount of waiting time for the patient and at the least possible cost to the hospital and the patient.

Determining the right staffing level is difficult with a service department such as radiology because of the problem in measuring productivity. Each radiologist works at a different speed, and there are many other variables (patient's age, type of examination, and speed of radiologic technicians, for example) over which the radiologist has little control but which affect his output. As the American College of Radiology points out, medical problems presented by

patients referred to radiologists vary widely from hospital to hospital, as do the amounts and the types of teaching and research provided by the hospital.[1] All of these variables have a direct effect upon the number of patients a radiologist can examine.

This research project is justified by the need for a suitable staffing guide in radiology departments. With the growing concern over increasing medical costs and the shortage of radiologists, as well as an increased emphasis upon the quality of patient care rendered, it is important that hospitals provide the appropriate number of radiologists.

Hospital Setting and History

Originally, Douglas County Hospital began as a pest house and a poor farm on its present site in 1888. The first units of the present structure were erected in 1931 and were used exclusively for tubercular and mental patients. Medical progress reduced this need, and these units were converted for central medical care. Major expansion from 1963 to 1966 enlarged the structure to its present 496-bed capability and enabled the hospital to provide modern comprehensive medical care.

Douglas County Hospital is a short-term general hospital and is affiliated with both the University of Nebraska

College of Medicine and the Creighton University School of Medicine. Each school has two floors within the hospital--one each for the medical service and the surgical service. These combined services account for 144 medical-surgical beds. There are also 27 beds for rehabilitation and 86 for psychiatry, making a total of 257 acute beds. There are 239 beds designated for chronic and extended care patients.

The hospital treats both private and charity patients. In 1969, private patients made up only 8.6 per cent of the admissions; the remainder were Medicare, Medicaid, or county welfare patients. Percentage occupancy was 70.2, and average patient stay was 14.4 days, with an average daily census of 172.8. There were 10,693 patients treated in the emergency room, and 1,310 surgical procedures were performed. The above figures do not include the chronic section of the hospital.

The hospital has an active staff of 13 physicians, who are department heads from the two medical schools. There is a total of 219 attending and consulting physicians, who are all associated with one of the schools. This is a prerequisite for becoming a member of the staff at Douglas County Hospital. There is an average of 16 interns and residents in training. They normally spend three months at

Douglas County Hospital and are then rotated to another hospital affiliated with the medical schools. Nursing service consists of 62 registered nurses, 35 licensed practical nurses, and 161 nurse's aides and orderlies. There are 619 full-time and 251 part-time employees.

Five members on the board of county commissioners from Douglas County are the governing board of the hospital, and the hospital administrator or the medical director has direct communication to the board through the chairman of a committee on health care and hospitalization. The hospital organization is depicted in Appendix A.

The dean's committee, which replaces the usual executive committee, consists of the deans of both medical schools and their directors of the departments of medicine and surgery and the medical director of Douglas County Hospital. The committee is responsible for nominating members for appointment to the medical staff. It insures that adequate medical and surgical services are provided and that education and training for all medical students are maintained above acceptable standards.

The two medical schools staff the emergency service of the hospital on alternating days. If a patient is admitted to the hospital from emergency, the school which is

covering the service that day receives the patient. This arrangement has proven to be most equitable.

In return for use of the county hospital as a teaching facility, the University of Nebraska and Creighton University have agreed to staff the rehabilitation and the psychiatric services, respectively. Creighton University provides a resident radiologist, while the University of Nebraska staffs pathology.

Conditions Which Prompted the Study

Since Douglas County Hospital is a teaching facility as well as a service institution, the dean's committee has questioned the adequacy of the time the staff radiologist is able to devote to supervision of the department, patient care, and education of the medical students within the hospital. The committee feels that all areas are important and agrees that the radiologist staffing level should allow for ample time to be devoted to all areas of concern.

Statement of the Problem

The problem is to determine the best staffing guide for radiologists in the radiology department of Douglas County Hospital, Omaha, Nebraska.

Objectives

The objectives of the study are:

1. To analyze the existing method of staffing the radiology department.

2. To determine and evaluate the workload of the radiology department.

3. To discuss three alternative methods for determining the number of radiologists needed.

4. To survey selected hospitals throughout the country to ascertain the criteria used for determining the number of radiologists needed.

5. To recommend a coefficient for use in a formula to determine the number of radiologists required.

Criteria

There are no universal criteria which all staffing guides must meet in order to be acceptable. At the present time, the American College of Radiology has no standards for establishing a staffing guide for radiologists. Consequently, all hospitals use a variety of methods to arrive at an appropriate staff level.

Each hospital must consider the many variables existing within that particular institution. For example, not

all hospitals have the same type of patient. This has a tremendous bearing upon the various departmental workloads. No two hospitals have the same educational requirements, nor do all have the same type research programs, if any at all. No staffing guide can be determined until these variables and many others are evaluated to determine their effect upon the workload of the department under study.

The proposed staffing guide for Douglas County Hospital should:

1. Conserve manpower resources.

2. Insure proper and timely radiology service to the hospital physicians and the patients.

Assumptions

This study is based upon the following assumptions:

1. The number of beds allocated for acute and chronic patients will not change markedly.

2. The hospital will continue to be affiliated with the University of Nebraska College of Medicine and the Creighton University School of Medicine.

3. One full-time radiology resident will continue to be provided.

4. The hospital will not establish an outpatient service.

5. The hospital will continue to have a high chronic and geriatric patient census.

6. The hospital will continue to provide only radiographic diagnosis examinations.

Research Methodology

The following research methodology was used in this study:

1. Interviews were held with the medical director, the chief of radiology, and the administrative assistant to the radiologist to determine the present organization and functions of the radiology department.

2. Interviews were conducted with house staff members, residents, interns, and day head nurse of each medical and surgical service to determine the adequacy of service provided by the radiology department. Residents and interns were asked if they felt they were receiving adequate training and education in radiology while at Douglas County Hospital.

3. An analysis of the radiology workload was made to determine the number and the types of examinations performed, the arrival times of patients, and the length of patient waiting time. Random samples, personal observation, a review of department records and reports, and a patient

questionnaire designed by the writer were used to gather the information. A questionnaire was completed on each patient examined during the month of March, 1970. (See Appendix B for a sample of the patient questionnaire.)

4. Personal observations were made of the work performed by the staff radiologist and the resident to determine their daily output and their work methods.

5. A questionnaire was mailed to 170 hospitals with a 200- to 600-bed capacity. (See Appendix C for a sample of the hospital questionnaire.) These hospitals were selected from the 1969 guide issue of Hospitals by using a random number table. All special hospitals and military hospitals were excluded from the selection. A comparative analysis of the data was made to ascertain the method used to determine the number of radiologists required in a radiology department.

Review of the Literature

The department of radiology is one of the most essential sections of the hospital, providing a service to nearly every patient admitted. Radiological charges are usually close to 8 to 10 per cent of all the income a hospital receives from patients.[2]

The chief of radiology should be a graduate of an acceptable medical school, duly licensed and specifically

trained in radiology. He must be a member of the medical staff, must attend medical staff conferences, ward rounds, lectures, and staff committee assignments, and must assist in education and training and similar functions of the institution. He must be responsible for the total management and professional activities of the department.[3]

A review of the literature showed that very little had been written specifically about a staffing guide for radiologists in a hospital radiology department. There are, however, a few articles or books which dwell very briefly upon some workload figures which could be used to help determine the number of radiologists required.

The Department of the Army has published a pamphlet for staffing U. S. Army medical department activities. This is a comprehensive guide which does lend itself to certain applicability within a civilian institution. Using examimations completed monthly as a basis of measurement, the number of radiologists required is then determined. The guide is divided into five workload levels of examinations completed. For 3,000 examinations completed, one radiologist is recommended. For 5,000 to 10,000 examinations completed, two radiologists are recommended, and for 30,000 to 40,000, the recommended staffing level is three. There is an

interval rate to compute requirements when the number of radiological examinations done monthly is an amount between the figures published. Computation of this interval rate is explained in the pamphlet.[4]

In a recent article, John Knowles indicated that 20 to 30 examinations per day or 7,000 to 9,000 per year is optimal for one radiologists without a teaching responsibility.[5] In a book of selected problems in hospital administration, it was written that some eminent radiologists recommend that there be at least one certified radiologist for every 9,000 examinations yearly, not including survey films of the chest. Anything over 9,000 examinations does not allow the radiologist time to properly consult with referring doctors, to teach, or to attend clinical meetings or conferences.[6]

One author used patients seen as a measurement in determining the number of radiologists required. He wrote that a radiologist can expect to see about 6,000 patients yearly. He did specify that the type of examinations performed would have some bearing upon the total number of patients seen.[7] Studies at UCLA Medical Center and John Hopkins University revealed that the time-consuming, complex, special radiologic studies are increasing at a rate of 30

per cent annually. A radiologist can accomplish from four to six of these a day.[8] Although special techniques are used in fewer than 3 per cent of all examinations, they occupy about 25 per cent of the professional manpower in diagnostic radiology.[9]

A technique sometimes used for determining staffing requirements is timing each examination performed to determine the amount of time an individual spends doing the examination. Once this is known, the information can be put into a formula to determine the total man-hours required for a specific workload.[10] This type of approach was excluded from this study due to the length of time required to obtain the standard times for each examination in the Douglas County Radiology Department.

The number of hospital beds has been used as a measurement criterion. Malcolm T. MacEachern in his book writes that hospitals under 100 beds should have one part-time radiologist; those with 100 to 200 beds should have one part-time to full-time radiologist. There should be one to three full-time radiologists for 200 to 300 beds, and two to four full-time radiologists are needed for hospitals with 300 to 500 beds.[11]

A survey conducted by the American College of

Radiology in 1964 showed that in hospitals with 100 to 200 beds there was an average of 1.15 full-time radiologists. Those with 200 to 300 beds averaged 2.15; those with 300 to 400 averaged 3.50. Those hospitals from 400 to 500 beds averaged 3.60 full-time radiologists.[12]

Regardless of the criterion used to determine the number of radiologists, it should be remembered that the radiologist's output can be affected by other factors. For example, the physical size of the department can affect his workload. In general, a diagnostic room can handle 20 to 25 examinations per 8-hour day.[13] If adequate facilities are not available, then the radiologist's workload will be reduced. Another factor to consider is the capability of the X-ray technicians supporting the radiologist. At the present time, a technician can perform examinations on a maximum of twenty patients per day.[14] Film-processing time can greatly increase the speed with which a radiologist can work. The trend has been a conversion to faster processing--7 minutes to 3-1/2 minutes to 90 seconds.[15] Being able to view a film in a matter of seconds not only helps to reduce patient waiting time but also allows for more patients to be seen and more examinations to be performed. Douglas County Hospital has a 90-second processing machine.

Footnotes

[1]American College of Radiology (ACoR), A Guide for Radiologists (Chicago: American College of Radiology, 1969), p. 3.

[2]Theodore T. Ott and Thomas P. Weil, "Management Aspects of the Department of Radiology," Radiologic Technology, XXXVII (May, 1966), 321.

[3]ACoR, A Guide for Radiologist, p. 3.

[4]U. S., Department of the Army, Staffing Guide for U. S. Army Medical Department Activities, DA Pamphlet 616-557 (Washington, D. C.: Government Printing Office, June, 1969), pp. 2-32.

[5]John H. Knowles, "Radiology--A Case Study in Technology and Manpower," New England Journal of Medicine, CCXXC (June 5 and 12, 1969), 1273.

[6]American College of Hospital Administrators, "Expanding the Radiology Department," in Selected Problems in Hospital Administration (Chicago: American College of Hospital Administrators, n.d.), p. 201.

[7]S. W. Donaldson, "Practice of Radiology in the United States," American Journal of Roentgenology, LXVI (December, 1951), 931.

[8]J. E. Miller, "Radiologist's Dilemma," Texas Medicine, LXII (June, 1966), 32.

[9]"Shortage of Radiologists," British Medical Journal, II (October, 1957), 70.

[10]John G. Steinle, "Consultant's Corner," Hospital Topics, XXXV (December, 1957), 70.

[11]Malcolm T. MacEachern, Hospital Organization and Management (3rd ed.; Berwyn, Ill.: Physicians' Record Company, 1962), p. 437.

[12]Wendell G. Scott, ed., Planning Guide for Radiologic Installations (2nd ed.; Baltimore: Williams and Wilkens Co., 1966), p. 35.

[13]Robert R. Cadamus, "Efficient Layout of the Radiology Department," Hospitals, XL (May 1, 1966), 68.

[14]"Automation in Diagnostic Radiology--A Critique," Radiology, XCIII (September, 1969), 700.

[15]James Ohnysty, "Economics of the Department of Radiology and the Radiologic Technologist," Radiologic Technology, XL (March, 1969), 286.

CHAPTER II

DISCUSSION

Present Organization and Staffing

There is a group of eight radiologists (Radiology Consultants, Inc.) who provide the staff for the radiology department of Douglas County Hospital. Seven are certified by the Board of American Radiologists. One of the eight is appointed as chief of the department. In addition, this group in conjunction with Creighton University provides a second-year resident in radiology from Creighton University who works in the department on a full-time basis. Creighton University and the group of radiologists share equally in the payment of the resident's salary. A complete breakdown of the radiology department staff and organization is shown in Appendix D. This group of radiologists staffs the radiology department of St. Joseph's Hospital (which is the teaching hospital for Creighton University) and also those of several other hospitals in and around Omaha.

At the present time, there is no formal written contract or agreement between the hospital and the radiologists as to the staffing of the department. Based upon a personal

agreement between the hospital administrator of Douglas County Hospital and the spokesman for the practicing radiologists, the group of radiologists is to provide proper and adequate coverage for the radiology department. The administrator has established no other specific criterion for this coverage, and the manner in which it is provided is left entirely to the discretion of the staff radiologist.

Presently there are no specific criteria used in determining the number of radiologists required at Douglas County Hospital. The number of beds is considered, but staffing is done primarily on a subjective evaluation of the amount of work the radiologist has to do. Although Douglas County Hospital is considered a 496-bed hospital, nearly all of the workload of the radiology department is generated from the 257 acute beds and the emergency service. Patients in the chronic care beds are normally transferred to one of the medical or the surgical services when radiologic diagnosis is required.

The staff radiologists provide their services on a rotating daily schedule. One radiologist each day--Monday through Friday--spends a part of each morning and each afternoon in the department. Normally, he arrives at about 8:00 A.M. and 3:00 P.M. He spends as much time as necessary

in answering any questions the resident may have on any films from examinations previously performed, and, when the workload dictates, he helps with any examinations scheduled for the day.

The radiologists feel that this method of staffing provides adequate coverage to the department and also allows the resident to gain a great deal of experience, knowledge, and confidence, since he essentially is left alone a major portion of the day to perform the major portion of the examinations and to interpret the films. He also becomes a teacher for the other students in the hospital. Many have found this method of training to be of great benefit to the resident and the student alike. The student will often ask questions of the resident that he would not ask of a professor, and the resident is generally quite current in the latest ideas and advances in the specialty.[1]

Normally, the chief of the radiology department spends part of one day in the week in the department in his normal rotation with the rest of the group. Since he is not in the department daily, the administrative assistant--who is the senior X-ray technician--is largely responsible for coordinating activities and managing the department. He provides the necessary supervision of the radiology technicians.

Although a staff radiologist is present at the hospital only about two to three hours a day, one of the group can always be reached by telephone for consultation and, if necessary, can be at the hospital within about fifteen minutes after notification. The staff radiologists are responsible for all-night and weekend coverage. This is handled on an "on-call" basis.

Present Work Method

The normal department operating hours are from 8:00 A.M. to 4:30 P.M., Monday through Friday. From 8:00 A.M. to 12:00 noon on Saturday, one technician is on duty in the department. From 4:30 P.M. to 8:00 A.M. Monday through Friday and from 12:00 noon Saturday to 8:00 A.M. Monday, one X-ray technician is on-call but remains at home.

The radiology department at Douglas County Hospital has four examining rooms. Room No. 1 is used to perform any emergency examinations and, when possible, is kept open for this purpose. Short routine examinations are performed if necessary, and no patient is kept waiting if this room is available and is needed. Room No. 2 is equipped with a 6-inch image intensifier and is used primarily for fluoroscopy examinations. It is also used for routine cases after all fluoroscopy studies are completed. Room No. 3 is a

routine diagnostic room and is normally used to perform gall bladder and intravenous pyelogram examinations. Room No. 4 is equipped with a 9-inch image intensifier and is used for all special procedures and for fluoroscopy examinations. Rooms 3 and 4 are also used for routine diagnostic examinations, once the fluoroscopy and the special procedures are completed for the day.

Each of the four X-ray technicians is assigned specifically to one of the rooms and is rotated to the rooms on a weekly basis. When necessary, the technicians in rooms 1 and 3 assist with patient handling and film processing in rooms 2 and 4, respectively.

The first patients are normally sent for as soon as the resident radiologist arrives in the morning. This is normally around 8:00 A.M., except on Tuesday and Thursday, when he does not arrive until about 8:30 A.M. because of a physics class he attends. Oftentimes, the staff radiologist will start the examinations on those days if there are several fluoroscopy examinations to be done.

As a rule, the staff radiologist does not help with the fluoroscopy examinations if the resident can complete them by noon, which is normally the case. Most afternoon examinations are normally routine in nature--such as chest

X-rays. All special radiographic examinations are scheduled in advance, and the staff radiologist performs all these procedures, assisted by the resident. These are normally scheduled late in the morning or at about 1:00 P.M. so that most of the fluoroscopy work can be completed before the longer special procedures begin.

There is no formal patient scheduling done at this time except for the infrequent special examinations. Once the fluoroscopy and the special examinations are completed, the routine patients are sent for as rooms become available. Emergency and stat patients have first priority and are seen immediately upon request.

The administrative assistant acts as a floor manager and coordinates the movement of all patients in and out of the department with the X-ray technicians and the orderly. There were some minor delays observed when a patient from one of the medical or the surgical services was not quite ready to be moved to the radiology department when the orderly arrived. These delays occurred mostly with the morning fluoroscopy patients. (Although of minor significance, specific scheduling of fluoroscopic examinations would help to alleviate this problem.)

The head nurses of the medical and the surgical

services as well as several members of the professional staff indicated that they felt the radiology department provided a very prompt and a more than adequate service. They had no complaints regarding the present system of calling for patients as the radiology service can handle them.

The staff radiologists spend very little time in teaching at the county hospital. Most of the radiological education is given at the respective medical schools. One of the radiologists holds a one-hour weekly radiology conference for the students at Douglas County Hospital, at which time a series of unusual examinations is shown and discussed. Additional education is provided the students by staff physicians each morning during ward rounds. In addition, the staff radiologists are available to attend, or conduct, teaching conferences if requested by the hospital or any member of the hospital staff. Many medical school radiology departments are so understaffed and so occupied giving patient service that they have little if any time for teaching.[2]

The examinations performed at the hospital are routine for the most part and provide very few unusual cases which are good for teaching purposes. Many of the special procedures are performed in surgery by a specialist, with no staff radiologist in attendance. It would appear that the

staff radiologist has ample time to devote to any teaching requirement at Douglas County Hospital; however, the time spent in teaching at present is minimal.

Workload

In order to develop a meaningful staffing guide, it is necessary to determine and evaluate the workload. As a starting point, an analysis was made of the radiology department's workload from January, 1965, through December, 1969, to make a prediction about the future workload of the department. The workload measurement is number of examinations performed monthly.

The statistical method of regression analysis was chosen to derive a linear trend equation. The linear equation "y = a + bx," which is the simplest and the most widely used, was selected for the analysis.[3] In this equation, "y" equals a period of time which, in this case, is months; "a" and "b" are numerical constants. In this case, "a" is a number of examinations and "b" is the change in examinations per month.

From the formula "y = a + bx," a number of examinations can be estimated for any given month simply by substituting the proper month for "x." In order to solve for "a" and "b," standard formulas found in most textbooks can be used.[4]

Two analyses had to be made of the 5-year period from 1965 through 1969 because only day examinations were accounted for from 1965 through 1967, while in 1968 and 1969 both day and night examinations were accounted for. Consequently, "a" and "b" had to be solved for two time frames. The resulting trend equations were:

$$1965\text{-}67:\ y = 918.73 + 4.5x$$

$$1968\text{-}69:\ y = 1715.86 - 7.87x$$

This analysis showed that, during the period when night examinations were not counted, there was a predicted increase of 4.52 examinations per month. When all examinations were accounted for, the regression analysis indicated that there was a decrease of 7.87 examinations per month. Based upon this analysis, it is anticipated that there will be no significant increase or decrease in the number of examinations performed in the near future. This information could have been presented graphically; however, this was not done since there was no significant change to be shown.

A review of the daily log of the radiology department was made of the year 1969. During the calendar year 1969, there was a total of 18,972 examinations performed and 14,954 patients seen in the department. (See Appendix E for types of examinations performed.) It was determined that a

more valid figure for looking at the overall workload would be the daily figures, since the radiologist was more directly involved with this portion of the workload. Very few nighttime or weekend patients were seen by the radiologist. In 1969, there was a total of 11,277 radiographic examinations completed and 9,283 patients seen during the day. Inpatients accounted for 73 per cent of these patients, and emergency room referrals totaled 17 per cent. The remaining 10 per cent included hospital employees and an insignificant percentage of patients classified as outpatients.

It is significant to note that chest admission examinations represented 42 per cent of the total day examinations. Routinely, this type examination takes only ten minutes to perform and does not require the radiologist's presence. Interpretation of this type film takes the radiologist about one minute to read.

Special examinations--such as bronchograms, cystograms, femoral arteriograms, translumbar arteriograms, aortic arch studies, renal arteriograms, sinugrams, and sialograms--averaged between 12 and 13 a month for 1969, as shown in Table 1 (see p. 26). Although these are time-consuming examinations and are normally done by both the staff radiologist and the resident, the number done each month was so small that it

TABLE 1

MONTHLY SUMMARY OF SPECIAL EXAMINATIONS
PERFORMED DURING THE YEAR 1969

Month	Number
January	10
February	7
March	11
April	6
May	14
June	14
July	15
August	21
September	17
October	14
November	14
December	9
TOTAL	152
Average per month	12.6

SOURCE: Monthly X-ray reports for 1969, Radiology Department, Douglas County Hospital, Omaha, Nebraska.

had little effect upon the overall workload of the staff. These special examinations represent only 1.3 per cent of the total examinations performed.

It has been found that ten fluoroscopy procedures per day for each radiologist is an optimum load.[5] The total daily fluoroscopy examinations at Douglas County Hospital during 1969 were well below this at 4.4, based upon 246 days of work for the year. Table 2 (see p. 27) reflects the monthly totals.

TABLE 2

MONTHLY SUMMARY OF FLUOROSCOPY EXAMINATIONS

Month	Number
January	110
February	75
March	87
April	86
May	90
June	82
July	74
August	114
September	98
October	120
November	79
December	87
TOTAL	1,102
Average per day	4.4

SOURCE: Monthly X-ray Reports for 1969, Radiology Department, Douglas County Hospital, Omaha, Nebraska.

An analysis was made of the records to determine the average number of examinations performed and patients seen per day. After consulting with the administrative assistant, it was determined that the months of January, May, and October of 1969 would approximate a typical workload.

Results of a survey conducted by the American College of Radiology, in November of 1968, indicated that each full-time radiologist sees less than 40 patients per day.[6] As shown in Table 3 (see p. 28), the radiologist at Douglas

TABLE 3

SUMMARY OF EXAMINATIONS PERFORMED AND PATIENTS SEEN EACH DAY OF THE WEEK

Day	Average No. of Exams Performed	Average No. of Patients Seen
Monday	48	40
Tuesday	42	32
Wednesday	46	38
Thursday	44	35
Friday	44	34
Total daily average	44.8	35.8

SOURCE: Daily log for 1969, Radiology Department, Douglas County Hospital, Omaha, Nebraska.

County Hospital saw an average of 35.8 patients and performed 44.8 examinations per day in 1969.

During the month of March, 1970, a patient questionnaire (Appendix B) was filled out on every patient who was seen in the radiology department. This was used to determine patient arrival times and waiting times, as it was felt that any abnormalities in these areas would directly affect or be affected by the radiologist. The March workload was comparable to that of the average month in 1969, with inpatients representing 71 per cent of the workload and emergency patients and employees 18 and 11 per cent, respectively. The

average age of the patients seen during the month was 52, and 32 per cent of the patients were 65 or older. Patient age is an important factor, as it often takes twice as long to do examinations on elderly persons.[7] There were 1,005 questionnaires completed in March; however, only 803, or 80 per cent of the total, were used. The remainder were excluded because of incorrect or incomplete entries on the questionnaire. Patient arrival time (as shown in Table 4) indicated a rather uniform distribution, with slightly fewer being seen in the first hour of the day, when fluoroscopy examinations were being done. This relatively even distribution is considered to be due to the present scheduling method used by the administrative assistant.

TABLE 4

SUMMARY OF PATIENT ARRIVAL TIMES DURING MARCH, 1970

Patient Arrival Time	No. of Arrivals	Per Cent of total Arrivals
8:00-8:59 A.M.	90	11
9:00-9:59 A.M.	121	15
10:00-10:59 A.M.	134	17
11:00-11:59 A.M.	58	7
12:00-12:59 P.M.	30	4
1:00-1:59 P.M.	153	19
2:00-2:59 P.M.	123	15
3:00-3:59 P.M.	73	9
4:00-4:59 P.M.	21	3
TOTAL	803	100

The effectiveness of the method of sending for the patient as rooms become available is clearly demonstrated in the analysis of patient waiting time shown in Table 5. Patient waiting time was computed from the time the patient arrived in the department until the examination began. Ninety per cent of the patients had to wait ten minutes or less for examinations to begin. The longest waiting time was thirty minutes.

TABLE 5

SUMMARY OF PATIENT WAITING TIME DURING MARCH, 1970

Waiting Time in Minutes	No. of Patients	Per Cent of Total Patients Examined
1-2	317	40
3-4	86	11
5-6	209	26
7-8	19	2
9-10	98	12
11-12	5	0.6
13-14	3	0.4
15-16	39	5
17+	27	13
TOTAL	803	100

These data were not collected under ideal analytical circumstances in that the workers within the department who were completing the patient questionnaires were informed of the study. However, during the writer's 2-week visit in the

department, personal observations were made of patients on a random basis, and it was found that the reported data were accurate.

Alternative Workload Measurements

An appropriate staffing level is necessary if adequate quality care is to be given to the patient in an efficient and an economical manner. Having too few personnel to do a specific task can be detrimental to the care of the patient. Having too many personnel is not economically sound for the hospital or the patient. Overstaffing can only raise the cost of medical care for everyone concerned. Because of these factors, it is essential that the best workload measurement be used when determining the number of personnel required for any specific function.

Three alternative workload measurements which can be used to determine the appropriate number of radiologists required in a radiology department are: (1) the number of hospital beds, (2) the number of patients in the hospital, and (3) the number of examinations performed in the radiology department.

On the surface, the use of the first alternative--the number of hospital beds--would appear to be a good unit of measurement. Its major advantage is that there are

guidelines published in the literature, as was indicated earlier in this study. Collecting data for determining a radiologist-to-bed ratio would be relatively easy and would require little time. However, this method does not take into consideration the workload required of the radiologist. The length, the type, or the number of examinations is not considered. Changes in the trends of the workload are not reflected, which could result in having too many or too few radiologists at any given time. If a hospital provides an outpatient and/or an emergency service, a ratio based upon hospital beds fails to reflect this workload. It is no longer wise to use the old guides as to the relationship between beds and number of radiologists because more hospital patients are seeing the radiologist now than in the past.

The number of examinations alternative has as its main advantage the fact that trends in the workload are readily reflected. Patient input is considered, regardless of where it is generated. If desired, the time required for each examination can readily be used to determine the amount of work the radiologist does. There have been standard times published on various examinations. The disadvantage of this method is that collection of data is time consuming because the data must be detailed and accurate. Once the

material is recorded, it also takes a great deal of time to compute and analyze it.

Determining a staffing guide based upon the number of patients in the hospital has as its primary advantage the relative ease and the small amount of time required to obtain the necessary data needed to make the ratio computation. For the most part, once this information is obtained the patient census seldom fluctuates enough to require a change in the workload; however, it does not reflect the total patients seen by the radiologist. The major disadvantage of this alternative is that there are no guidelines published as to the ratio of radiologist to patients in the hospital. This solution does not consider the number and the length of examinations required by the patient. This information is essential if the true workload of the radiologist is to be determined with any degree of accuracy.

Survey Results

Since there is very little literature written about staffing the radiology department of a hospital, it was decided that a survey of randomly selected hospitals be conducted to obtain additional information in this area. Questionnaires were sent to 170 hospitals. Of these, a total of 60.6 per cent completed and returned the questionnaire.

The hospitals responding were all short-term general facilities and fell under five categories of control: city-county-state, church, other nonprofit, for profit, and Veterans Administration. The number of returns is shown by hospital control classification in Table 6.

TABLE 6

HOSPITALS SURVEYED

Hospital Control	No. of Hospitals Surveyed	No. of Returns	Per Cent
City-county-state	42	28	66.6
Church	51	37	72.5
Other nonprofit	59	32	54.2
For profit	10	3	30.0
Veterans' Administration	8	3	37.5
TOTAL	170	103	60.6

The questionnaire was designed primarily to gain information as to how each hospital determined the number of radiologists required and what the workload was for each radiologist. Since this study is only concerned with a radiology diagnostic service, questions were asked about the therapeutic workload so that these figures would not erroneously be included in the diagnostic totals. (See Appendix C.)

An analysis was made of the questionnaire, and each

hospital was placed under the criteria it used for determining radiologist requirements. Table 7 reflects the various criteria used. Examinations were used by over 50 per cent of the reporting hospitals as the sole criterion to determine requirements, and examinations were used as at least part of the criteria in 82.5 per cent of the hospitals.

TABLE 7

CRITERIA FOR STAFFING

Criterion	No. of Hospitals	Per Cent
Examinations	54	52.4
Patients	1	1.0
Beds	0	0
Beds, Patients, Examinations Combination	15	14.6
Examinations and Patients	14	13.6
Examinations and Beds	2	1.9
Other	17	16.5
TOTAL	103	100.0

With one exception, none of the hospitals indicated a specific ratio which they used for staffing radiologists under a particular criterion. For example, if a hospital reported using examinations as a guide, it did not specify the number of examinations performed by one radiologist.

In order to determine this information, the total number of examinations was divided by the total number of radiologists, and this gave an overall average of the number of examinations performed by one radiologist under that criterion. This method was used to evaluate each criterion.

Only one hospital reported using patients as a criterion. The ratio for this hospital was one radiologist per 12,000 patients yearly. Based upon results of the 1968 survey made by the American College of Radiology, this is a realistic ratio of radiologist to patient.[8]

Not a single hospital used beds as a guide by itself. This was especially interesting to note since, as mentioned earlier, the only guides found for staffing radiologists were based upon the number of hospital beds.

For those hospitals using the combination criterion of beds, patients, and examinations, ratios were determined for all three categories. There was one radiologist per 9,371 patients, per 10,789 examinations, and per 122 beds.

Under the examinations-patient criterion, the ratio was one radiologist per 6,920 patients and per 10,909 examinations. The examinations-beds criterion had a ratio of one radiologist per 112 beds and per 10,777 examinations. Considering all these ratios, it is apparent that the only

criterion which remains consistent is examinations.

The hospitals categorized as "other" were not concerned with the workload to any degree. Eight of the hospitals indicated that determining the number of radiologists was a subjective evaluation, and, when the radiology departments asked for another radiologist, they got one. Five hospitals used an open staff to obtain their radiologists, so they felt there were no quantitative criteria needed.

The hospitals using examinations as a criterion were further divided into control categories to determine if there was any significant difference in the radiologic workload among these groups of hospitals. Table 8 shows the

TABLE 8

RATIO OF RADIOLOGIST PER EXAMINATIONS

Hospital Category	No. of Hospitals	Average Monthly Exams per Radiologist
City-county-state	18	948
Church	22	913
Other nonprofit	10	942
For profit	1	259*
Veterans Administration	3	1,203
TOTAL	54	1,051

*This figure excluded from total average because of sample size and large variance from other figures.

relationship. With the exception of the for-profit and the Veterans Administration hospitals, the ratio was nearly the same. Comments on the questionnaires from the Veterans Administration hospitals indicate that these hospitals have trouble obtaining radiologists and would prefer a lower workload per radiologist, if they could obtain the services of more. This writer cannot explain the large variance in the for-profit hospitals. The sample size of only one makes it impossible to evaluate.

Staffing Guide

Since the criterion of examinations was used in over 50 per cent of the hospitals surveyed and since it appears that examinations measure the radiologic workload more accurately than any other criterion, it was decided to determine the average number of examinations per radiologist for the 103 hospitals that answered the questionnaire. This was done by adding all the examinations performed and dividing this total by the total number of radiologists. This resulted in a ratio of one radiologist for 10,816 examinations a year, or 901 per month.

In order to determine if this was a valid relationship between the two variables--radiologists and examinations--a regression analysis was done on the reported data.

The linear equation "y = a + bx," which was discussed earlier, was used to establish a line reflecting the relationship between the two variables. The resulting trend equation was "y = .380 + .000088x." "Y" in this case equals radiologists, and "a" is the number of radiologists required to perform no examinations. It is realized that, normally, if there are no examinations, there will be no radiologist required; however, this artifact is part of the regression analysis technique. The number of radiologists per examination is "b," and "x" is the number of examinations performed per period of time, which in this analysis is one year. In order to find "y," all one need do is substitute the number of examinations performed or expected to be performed for "x." This relationship is shown graphically in Appendix F. The analysis indicated that at least one radiologist would be required for the first 7,000 examinations; however, it is shown that, on the average, one radiologist performed approximately 10,500 examinations. This verified that the ratio of one radiologist per 10,816 examinations, as determined by a simple averaging, was quite accurate.

As shown in Appendix F, a guide indicating the number of radiologists required for a specific workload can be derived from the scatter diagram. This is an excellent

technique for establishing a guide; however, most individual hospitals do not have the time or the resources available to them to conduct the necessary research for gathering data for this type analysis. Douglas County Hospital or any hospital could use the analysis done in this study, but it should be remembered that a study of this type should be updated periodically so that technological advances or changes in professional procedures would be reflected in the variables "a" and "b" of the regression formula.

A formula which can be applied to Douglas County Hospital for determining the number of radiologists needed for a given workload is one used by the U. S. Army in determining its staffing requirements.[9] The standard work month in hours is divided by the workload which can be performed by one radiologist in one month. This will determine a coefficient. Once this is determined, the workload presently being done in the radiology department can be multiplied by the coefficient, and this answer is then divided by the standard work month, which will result in the number of radiologists required. For example, using 901 examinations as the workload one radiologist can perform in one month, as determined by the writer's survey (this was derived by dividing 10,816 examinations by 12), the following coefficient is derived:

$$\frac{\text{Standard Work Month in Hours (160)}}{\text{Workload Which Can Be Performed by One Radiologist in One Month (901 Examinations)}} = .177 \text{ Coefficient}$$

Using the average number of examinations performed per month in 1969 at Douglas County Hospital as the current or the predicted workload, the following formula results in 1.74 as the number of radiologists required for 1,579 examinations:

$$\frac{\text{Workload (1,579 Exams)} \times \text{Coefficient (.177)}}{\text{Standard Work Month in Hours (160)}}$$
$$= 1.74 \text{ Radiologists}$$

This formula provides the hospital administrator with a guide for staffing and will still allow a subjective evaluation of any qualitative factors which he might want to consider. As in the case of this example, the administrator could have one full-time radiologist and another working part time about three-fourths of the time, or he could have two full-time radiologists and be assured of being able to provide prompt service and time for the radiologist to fulfill any teaching requirements within the hospital.

This formula is particularly suitable for use by individual hospitals, since the only information they need to acquire from an outside source is the workload which a radiologist can perform in one month. It is highly probable

that in the near future this information could be obtained from the American Hospital Association through its hospital administrative service or from the American College of Radiology. This would preclude the individual hospital having to do a detailed analysis as described earlier.

Summary

The purpose of this paper was to determine the best staffing guide for radiologists in the radiology department of Douglas County Hospital, Omaha, Nebraska.

At the present time, Douglas County Hospital is staffed each day with a full-time resident and one staff radiologist who is in the department on the average two-to-three hours each day.

Adequate staffing is necessary to serve the greatest number of patients at the time that care is required or desired by the patient. It is essential that this care be provided at the lowest possible cost to the patient and the hospital. Proper staffing of personnel can aid in achieving a lower cost.

The problem of determining the number of radiologists needed within a department is a complex one because of the many variables which must be considered. The research methodology used included interviews with key personnel

throughout the hospital, analysis of the radiology department's workload from department records and personal observations, a review of the literature, and a survey of 103 hospitals throughout the country.

Three alternative methods of staffing guidance were discussed. Under the number of beds alternative, the major advantage was that there was at least one published guide in the literature. The ratio of radiologists to beds was provided. The greatest disadvantage of this method was that it does not take into consideration the actual workload of the radiologist.

The number of patients method had as its main advantage the ease and the small amount of time required in collecting data to determine the ratio; however, there were no established guidelines published as to the number of radiologists required for a certain number of patients. This method does not reflect an accurate measurement of the radiologic workload.

A staffing guide based upon the alternative of number of examinations had as its greatest advantage the fact that trends in the workload are reflected. The major disadvantage was that complete, accurate, and detailed records must be maintained.

Results of the survey indicated that the most common criterion used by hospitals to determine radiologic requirements was the number of examinations. The average workload was one radiologist per 901 examinations per month.

A formula used by the U. S. Army to determine its staffing requirements was discussed as having application at Douglas County Hospital.

Footnotes

[1]Bruce C. Paton, "Are Residents Good Teachers of Medical Students?," Hospital Physician, VI (January, 1970), 73.

[2]Clyde A. Stevenson, "Problems in Radiology of Today and the Future," American Journal of Roetgenology, XCVIII (December, 1966), 779.

[3]John E. Freund and Frank L. Williams, Elementary Business Statistics (Englewood Cliffs: Prentice-Hall, Inc., 1964), p. 297.

[4]Ibid., p. 307.

[5]Dov Kanon, "Scheduling System for X-Rays Prevents Overtaxing of Facilities," Hospitals, XLI (January 1, 1967), 89.

[6]American College of Radiology (ACoR), "Summary of Survey of Practice of Radiology," Chicago, November, 1968, n.p. (mimeographed).

[7]Knowles, "Radiology," p. 1272.

[8]ACoR, "Summary of Survey of Practice of Radiology," n.p.

[9]U. S., Department of the Army, Adjutant General School, Manpower Control Officer Course, "Staffing Guides," Ft. Benjamin Harrison, Indiana, January 11, 1967, p. 4 (mimeographed).

CHAPTER III

CONCLUSION

Conclusion

The best guide for staffing radiologists in the Douglas County Hospital Radiology Department, Omaha, Nebraska, is based upon the number of examinations, with a coefficient of .177 applied against the workload performed in the radiology department.

Recommendations

It is recommended that:

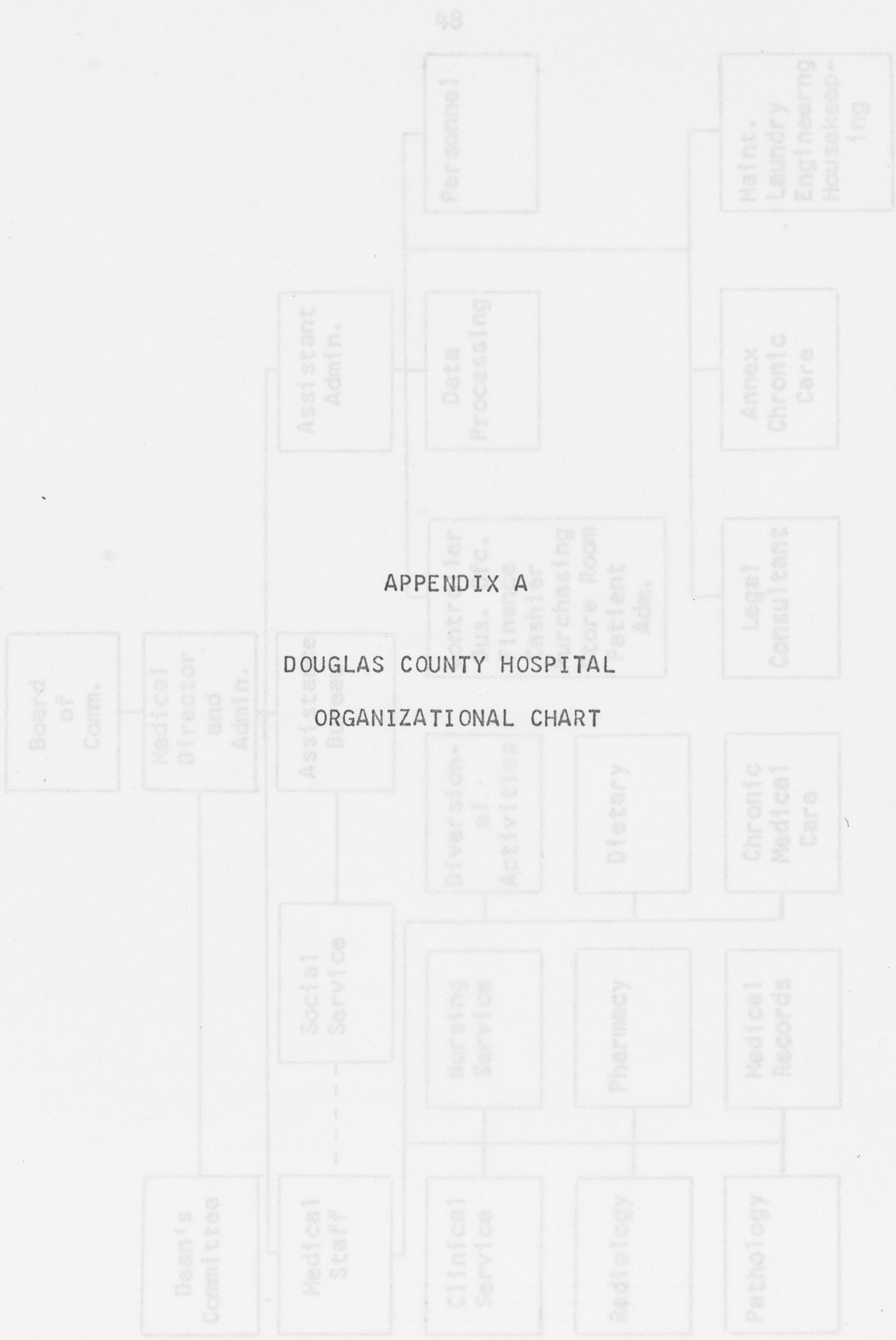
1. The following formulas be used to determine the number of radiologists required:

$$\frac{\text{Standard Work Month in Hours}}{\text{Number of Exams Which Can Be Performed by One Radiologist per Month}} = \text{Coefficient}$$

$$\frac{\text{Actual or Predicted Workload per Month} \times \text{Coefficient}}{\text{Standard Work Month in Hours}} = \text{Radiologists Required}$$

2. Nine hundred one be accepted as the number of examinations which one radiologist can perform per month.

It is further recommended that the dean's committee establish the teaching requirements of the staff radiologist.

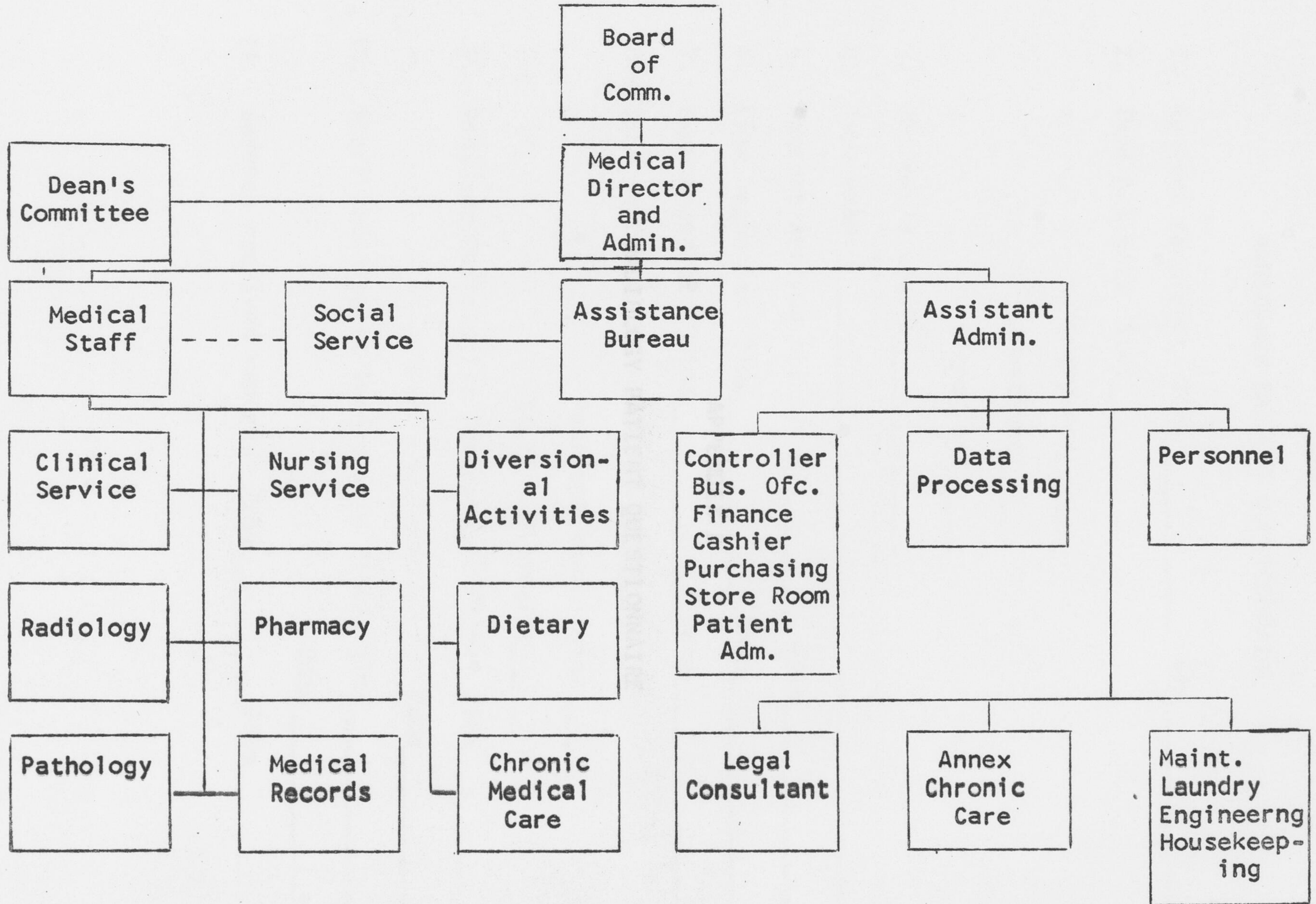


APPENDIX A

DOUGLAS COUNTY HOSPITAL

ORGANIZATIONAL CHART

DOUGLAS COUNTY HOSPITAL ORGANIZATIONAL CHART



APPENDIX B

RADIOLOGY PATIENT QUESTIONNAIRE

RADIOLOGY PATIENT QUESTIONNAIRE

1. Request received: Time____________ Date_____________
2. Type patient: Stat_____
   Emergency_____
   Inpatient_____
   Outpatient_____
3. Patient's age: ______________
4. Type exam: ____
5. Patient arrived at: Time__________ Date_____________
6. Exam began at: Time_____________ Date_______________
7. Exam ended at: Time_____________ Date_______________
8. Exam performed by: Technician_____
   Resident Radiologist_____
   Staff Radiologist_____
9. Resident Radiologist interpreted film: Time__________
   Date__________
10. Staff Radiologist interpreted film: Time_____________
    Date_____________
11. Service received report: Time_________ Date_________

APPENDIX C

RADIOLOGY HOSPITAL QUESTIONNAIRE

RADIOLOGY HOSPITAL QUESTIONNAIRE

1. Number of hospital beds: ____________________

2. Total patients admitted, 1969: ____________________

3. Average monthly patient census 1969: ____________________

4. Total patients seen in diagnostic X-ray section, 1969: ____________________

   a. Total inpatients: ________________

   b. Total outpatients: ________________

   c. Total emergency patients: ________________

   d. Total employee patients (if not already included in previous totals): ________________________

5. Indicate total therapeutic examinations performed in 1969: ________________

6. Indicate total diagnostic examinations performed in 1969: ________________

7. Indicate total number of diagnostic films taken: ______

8. Indicate number of diagnostic radiologists:

   Full time (40 hours a week or more): ________________

   Normal work week: days ________ hours ________

   Part time (less than 30 hours a week): ________________

   Hours worked per week: ___________

9. How are radiologists paid: Contract ____ Salary ____

   Fee-for-service ____ Other (Indicate method) ________

10. Indicate number of resident radiologists working in diagnostic service: Full time ____ Part time ____
    If part time, indicate hours worked per week: ______

11. Does the radiologist perform both therapy and diagnostic duties: ______________________
    If yes, hours worked per month: ________________ (in diagnostic section)
    Exams performed per month in diagnostic section: _____

12. Check appropriate criterion used to determine number of radiologists required:
    a. Number of beds ____________
    b. Number of patients ________
    c. Number of examinations _____
    d. Other ___________________

13. Explain how number of radiologists required is determined from above criterion.

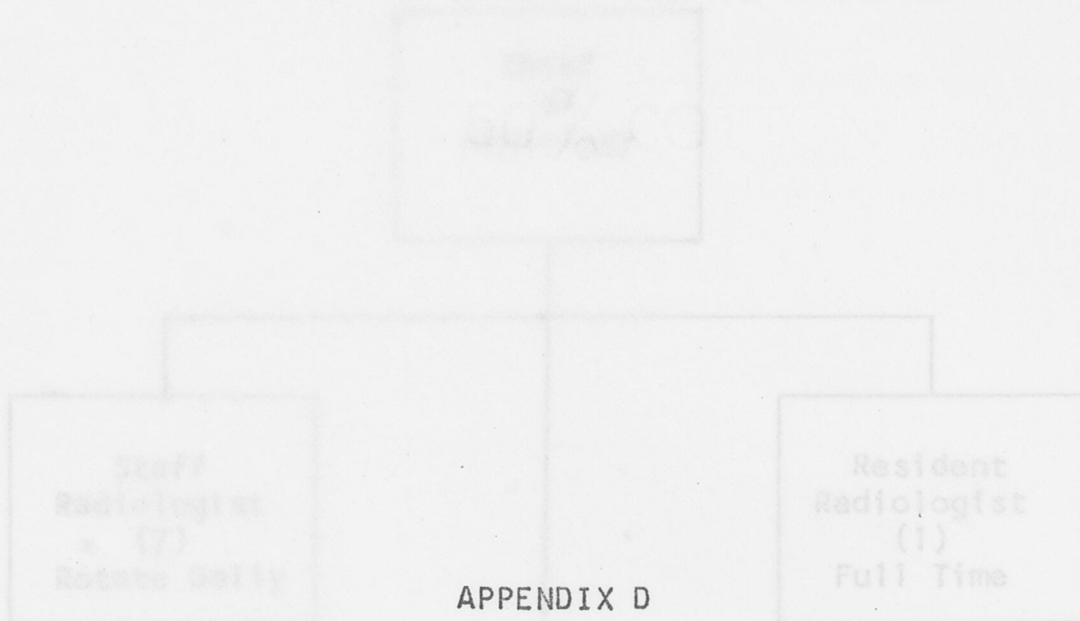
    ____

    ____

14. Comments:

____
Signature

____
Hospital

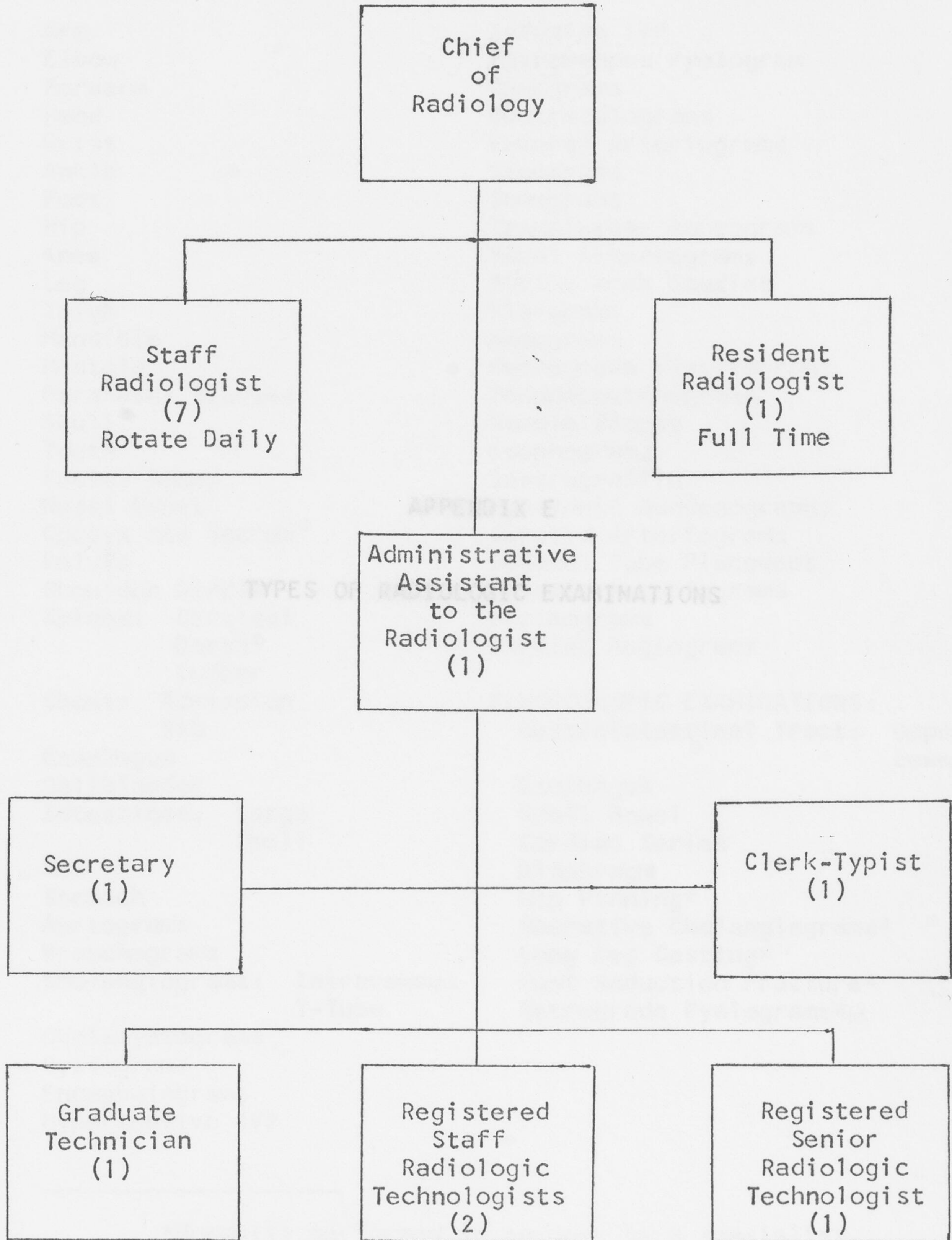


APPENDIX D

DOUGLAS COUNTY HOSPITAL RADIOLOGY DEPARTMENT

ORGANIZATIONAL CHART

RADIOLOGY DEPARTMENT ORGANIZATIONAL CHART



APPENDIX E

TYPES OF RADIOLOGIC EXAMINATIONS

TYPES OF RADIOLOGIC EXAMINATIONS

Arm
Elbow
Forearm
Hand
Wrist
Ankle
Foot
Hip
Knee
Leg
Thigh
Mandible
Mastoid
Paranasal Sinuses
Skull
Teeth
Facial Bones
Nasal Bones
Coccyx and Sacrum
Pelvis
Shoulder Girdle
Spines: Cervical
Dorsal
Lumbar
Chest: Admission
Rib
Esophagus
Gallbladder
Intestines: Large
Small
KUB
Stomach
Aortograms
Bronchograms
Cholangiograms: Intravenous
T-Tube
Cholecystograms
Cystograms
Encephalograms
Hypertensive IVP
Infusion IVP
Intravenous Pyelogram
Venograms
Ventriculograms
Femoral Arteriograms
Sinograms
Tomograms
Translumbar Aortograms
Renal Arteriograms
Aortic Arch Studies
Sialgrams
Mamograms
Retrograde Fistilograms
Pneunopeutonegrams
Needle Biopsy
Esophograms
Gastrograffin
Hypotonic Duodenography
Carotid Arteriograms
Jejunal Tube Placement
Hepatic Arteriograms
Ureteograms
Cardiac Angiograms

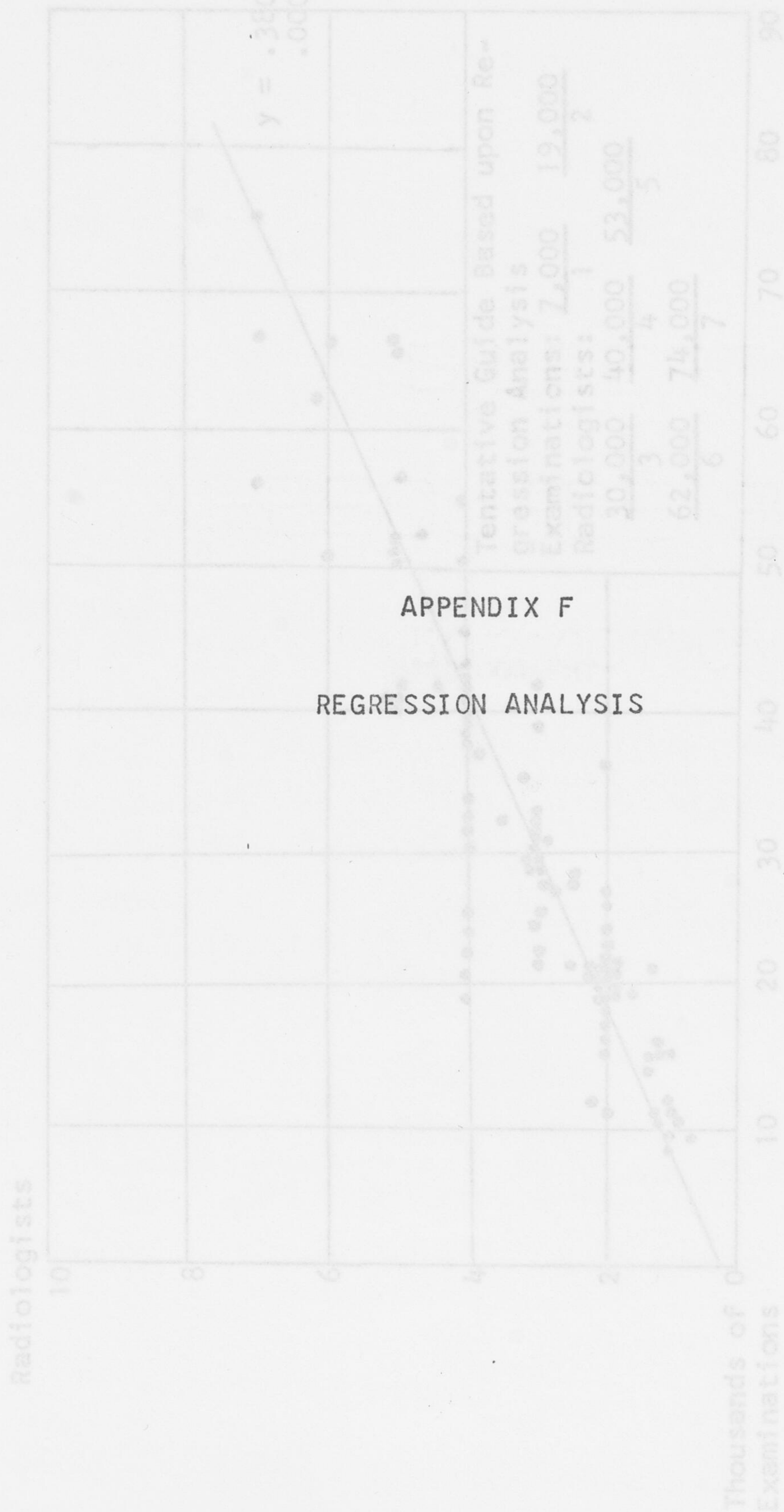
FLUOROSCOPIC EXAMINATIONS:
Gastrointestinal Tract: Upper
Lower
Esophagus
Small Bowel
Cardiac Series
Diaphragm
Hip Pinning*
Operative Cholangiograms*
Long Leg Casting*
Post Reduction Fracture*
Retrograde Pyelograms*

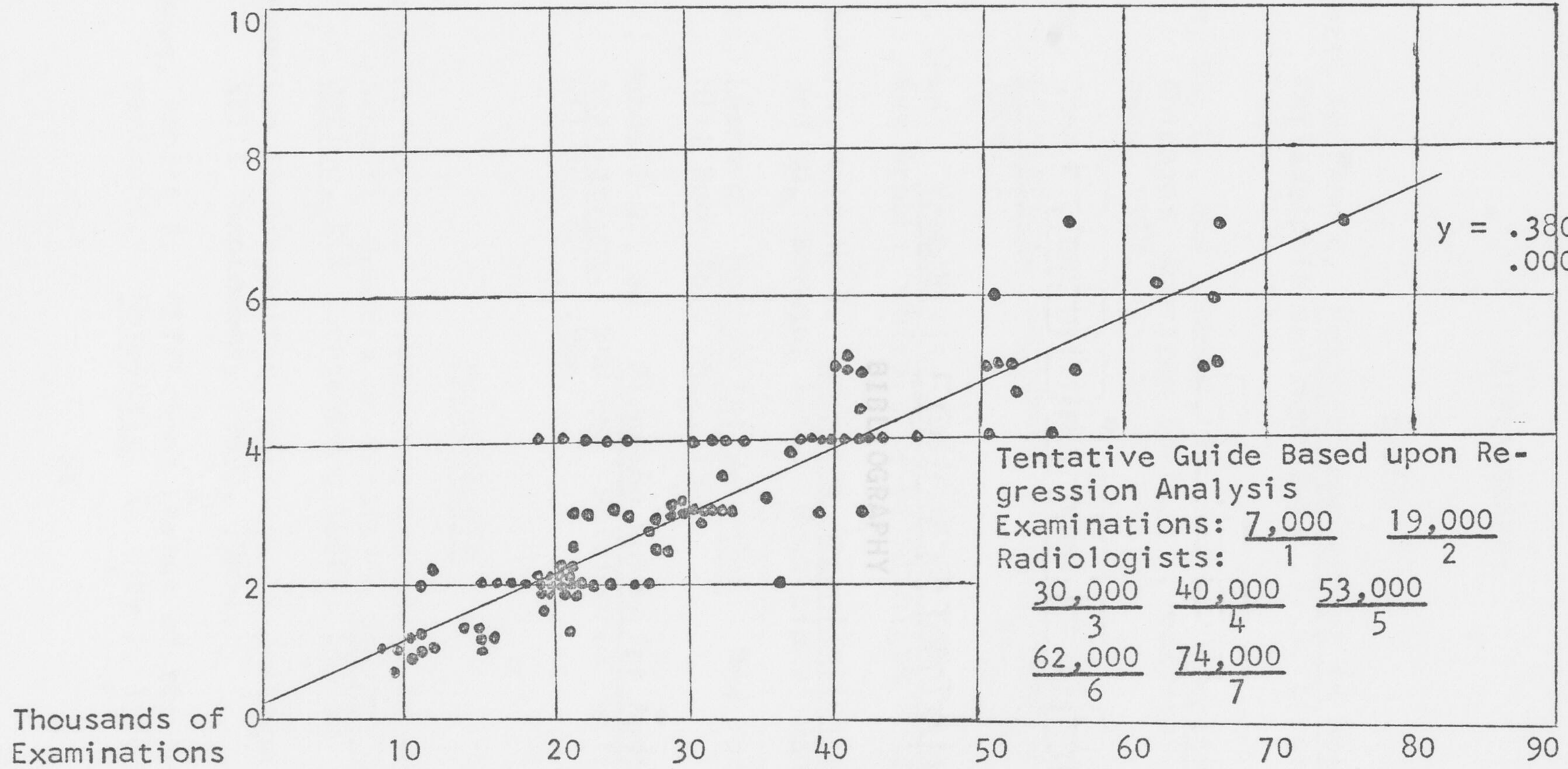
---

*Normally performed in surgery by a specialist.

APPENDIX F

REGRESSION ANALYSIS





NOTE: Examinations are rounded to nearest thousandeth.

REGRESSION ANALYSIS

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ABSTRACT

A STUDY OF THE RADIOLOGIST STAFFING LEVEL OF
DOUGLAS COUNTY HOSPITAL, OMAHA, NEBRASKA

A Problem Solving Thesis Submitted to the Faculty of Baylor University in Partial Fulfillment of the Requirements for the Degree of Master of Hospital Administration

by
Major David D. Dryden, MSC

August, 1971 65 Pages

A copy of this document may be obtained on interlibrary loan from Stimson Library, United States Army Medical Field Service School, Brooke Army Medical Center, Fort Sam Houston, Texas.

The purpose of this study was to determine the best guide for staffing radiologists in the radiology department of Douglas County Hospital, Omaha, Nebraska.

The research methodology included interviews with key personnel throughout the hospital, analysis of the radiology department's workload from department records and personal observations, a review of the literature, and a survey of 103 hospitals throughout the country.

Three alternative workload measurements were discussed: the number of beds alternative, the number of patients alternative, and the number of examinations alternative. Based upon the results of the survey, it was concluded that the best staffing guide for this hospital is based upon the number of examinations, with a coefficient of .177 applied against the workload performed in the radiology department.

It was recommended that 901 examinations be accepted as the workload of one radiologist per month and that the following formulas be used to determine the number of radiologists required:

$$\frac{\text{Standard Work Month in Hours}}{\text{Workload Which Can Be Performed by One Radiologist in One Month}} = \text{Coefficient}$$

$$\frac{\text{Workload X Coefficient}}{\text{Standard Work Month in Hours}} = \text{Number of Radiologists}$$

It was further recommended that the dean's committee establish teaching requirements for the staff radiologist.