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VARIABILITY IN OPERATING-ROOM SCHEDULING AT ST. ANTHONY HOSPITAL, OKLAHOMA CITY, OKLAHOMA

by

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CHAPTER I

INTRODUCTION

Conditions Which Prompted the Study

The administration and the nursing service at St. Anthony Hospital, Oklahoma City, Oklahoma, were aware that frequent gaps were occurring in the operating room schedules. In spite of periods of unused time during the prime portions of the day, surgery often extended into the late afternoon and evening. Some of these operations were scheduled electives, i.e., nonemergencies. Late surgery, in addition to causing some overtime payment of personnel, made it difficult to schedule proper coverage for the operating rooms. Another factor was the consequent delay in closure of the recovery room. Sometimes patients not fully recovered from anesthesia had to be transferred to the intensive care unit when the recovery room was closed for the night.

The above factors prompted St. Anthony Hospital to consider operating-room scheduling as a problem inviting examination. Since the study of variability in operating-room schedules is clearly a task of the administrator, it was

considered suitable for a project in the field of hospital administration.

Pertinent Background

The hospital--history and future

St. Anthony Hospital was Oklahoma City's first hospital and has remained its largest. Since they established it in 1898, The Sisters of St. Francis of Maryville, Missouri, have continually owned and operated it as a private, non-profit general hospital.

St. Anthony Hospital School of Nursing was established in 1908. The intern training program began in 1918 when the first intern class was accepted. Subsequently, with the development of residency training in various medical and surgical specialties, further house staff was added.

The present plant grew by stages, mainly around a major construction of 1917 which accommodated 125 beds. With additions, mostly in 1940 and extending from 1953 to 1960, the facility reached its 1967 capacity of 543 beds and 100 bassinetts. (Approximately 258 of the beds were considered surgical.) Future construction was subsequently planned to replace the aged core of the complex with a new high-rise main building. One-half of it is to be completed by January,

1970. At that time, its new operating rooms are to be occupied and the old building is to be demolished to make way for the second half of the construction.

In recent years, Oklahoma City had fifteen hospitals and one-quarter of the state's population. St. Anthony Hospital drew its patients from the city and the immediately surrounding regions, which were served by an additional twenty-three hospitals of smaller sizes.

The operating rooms

The history of the hospital partially explained why there were three separate operating room areas. They were known as North Surgery, South Surgery, and Eye Surgery. All were on the fourth story. The latter two surgeries were adjacent to one another, but North Surgery was located a full 100 yards away. There was a connecting corridor which also served the recovery room and the intensive care unit. In addition, it provided for general traffic to intervening orthopedic nursing units and some distant facilities.

Eye Surgery consisted of two operating rooms and a treatment room, all intercommunicating. It was located adjacent to the entrance to South Surgery. Nevertheless, it handled only eye cases, both in- and outpatient varieties.

On two afternoons a week, opthalmology clinics were held there.

North Surgery contained four operating rooms which were suitable for general surgery but were used only for orthopedic, urological, and dental operations. Within the same surgical area were three cast rooms and the cystoscopic room. The latter had an ancient cystoscopic table with X-ray capability. All other operations except Caesarean sections (done in the delivery rooms) were done in South Surgery. There, the following types of surgery were done: general, neurological, thoracic, plastic, gynecological, and ear, nose and throat. South Surgery contained nine adequate operating rooms, although two of them had less desirable lighting.

The operating room staff

Nursing service personnel.--The nursing service personnel functioned as independent groups in all three of the operating room complexes. There was no over-all operating-room supervisor; therefore, the supervisor of each of the three surgeries reported individually to the Director of the Nursing Service. Next in line to each of the operating-room supervisors was a head nurse. Following her were a number of professional nurses, licensed practical nurses, surgical

technicians, nurses' aides, ward clerks, and orderlies. All of these, in some cases over twenty-five at one time, were under the immediate direction of the operating-room supervisor. There were no intermediate levels of control. Each head nurse served mainly as an assistant to her supervisor and in the supervisor's absence acted in her place.

The surgeons.--As of January 1, 1967, the total number of physicians in all categories of the medical staff at St. Anthony Hospital was 382. Of these, exclusing eye and dental surgeons, over 150 had privileges to do operations in general surgery or in a surgical subspecialty. The extent of the individual surgeon's operating privileges and his status on the staff were determined by the credentials committee. Many of these surgeons had operating privileges in other hospitals as well. The St. Anthony Hospital governing board appointed a chief of surgery and a chief for each other specialty service.

The anesthesiologists.--All persons administering anesthesia at St. Anthony Hospital were physicians. As for the surgeons, the approval of the credentials committee was required to gain hospital privileges. On January 1, 1967, twenty-one anesthesiologists were listed on the staff,

approximately two-thirds of the Oklahoma City physicians who limited their practices to anesthesiology. Three of the twenty-one virtually confined their practices to St. Anthony, but the remainder served at other hospitals as well. Singly, each took twenty-eight-day turns at supervising interns who rotated through the anesthesia service.

Present method of scheduling

The ward clerk was supposed to do the scheduling. Although Eye Surgery was not observed, the following system was used in South and North Surgery.

The scheduling book pages were divided into nine horizontal areas, one for each room. Vertical columns were made to enter the time, the surgeon, the anesthesiologist, the procedure, and the age and name of the patient. As requests were received, the information was penciled into the space for one of the rooms at a level estimated to correspond to the time. (No hour markings were placed on the sheets in advance.) Cancellations were merely erased without record.

Two days in advance of each scheduled date for operations, the schedule book page was taken to the admissions office for copying. With such copies from all three surgeries, an integrated list was made. It was arranged alphabetically

by patients' names, giving the scheduled times, the names of the procedures, and the names of the surgeons. These lists were then distributed to places such as the patient care units, the administrative offices, and the doctors' lounge. Scheduling on the same page of the book was then resumed and continued right up to, and sometimes into, the date concerned.

The day before scheduled surgery, the operations were listed on a blackboard in the operating room corridor. This arrangement was chronological, a mixture of all rooms. A second board contained the operation of the current day. Referring to the appropriate board on the afternoon prior to the day being scheduled, the head nurse prepared an assignment sheet. Here, the operations were again rearranged according to the numbers of the operating rooms, and, for the first time, the nursing-service personnel were assigned to their particular cases.

CHAPTER II

THE PROBLEM

Statement of the Problem

The problem was to ascertain the causes and degree of the variability in surgical schedules at St. Anthony Hospital and to determine advisable measures for improvement. The objectives of this study are fully expressed in the foregoing statement of the problem.

Assumptions

The following assumptions are considered true:

1. Surgery will move into newly-constructed operating rooms by January, 1970, as planned.

2. Eye Surgery will remain a separate entity in the old facility as it is intended to be in the new one.

3. No extensive physical alterations are possible for the old operating rooms.

4. Since operating-room staffing needs to be adequate for the heaviest days, a reduction in variability in the daily operating schedule allows employment of the minimum

number of personnel.[1]

5. Limited staffing changes are possible while still in the old operating rooms.

6. Adequate numbers of nursing service personnel will remain available for the operating rooms.

7. Nursing service personnel will continue to cover certain night shifts through the home call system.

8. Saturday and Sunday surgery will continue to be limited mainly to emergencies.

9. Few operations are so urgent that they could not be fitted into a five-day week.[2]

10. Greater support from central supply will be possible by increasing the number of night-shift personnel.

11. Surgical beds will continue to be readily available.

12. Operating-room gross income is not likely to be reduced by confining elective surgery to regular day-time hours.

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[1]Gordon J. Davis and Ruddell Reed, Jr., "Variability Control Is the Key to Maximum Operating Room Utilization," The Modern Hospital, CII (April, 1964), 116.

[2]Leroy D. Vandam, "Significance of the Operating Schedule," Annals of Surgery, CLXI (January, 1965), 152.

Definitions

Clarification of the following terms, as applied in this study, is considered desirable:

1. Operating-room supervisor

A registered nurse in charge of one of the three operating-room complexes, such as South Surgery.

2. Head nurse

A registered nurse who is assigned as an assistant to and stand-in for an operating-room supervisor.

3. Professional nurse practitioner (staff nurse)

A registered nurse (R.N.) who performs general operating-room duties.

4. Licensed practical nurse (L.P.N.)

A graduate of an approved course of training, with subsequent examination and certification by the state, who is allowed to administer medications and perform general operating-room duties under the supervision of a registered nurse.

5. Surgical technician

An employee who, under nursing supervision, assists physicians while performing surgical procedures but who has no fixed state requirements for training or licensure and is not allowed to administer medications.

6. Nurse aide

An unlicensed person who is not allowed to administer medications but who performs nursing duties under the supervision of a nurse and, in the operating-room, usually prepares supplies in the workroom.

7. Ward clerk

The graduate of a three-week, inhospital course for ward clerks, whose duty in the operating room is to schedule the operations.

8. Orderly

The lowest-skill level of operating-room employees, who mainly wheels patients and performs courier duties.

9. Central supply technician

A person who prepares supplies (not in the operating room), gives no nursing care, and receives a lower salary than a nurse aide.

10. Scrub nurse

A registered nurse, licensed practical nurse, or scrub technician, who, in gown and gloves, passes instruments to the surgeon.

11. Circulating nurse

A registered nurse, licensed practical nurse, or

scrub technician, who moves about one or more operating rooms during an operation to provide supplies and other support to the scrubbed personnel.

12. Anesthesiologist

A physician who limits his practice to the administration of anesthetics.

13. Anesthetist

A nurse who administers anesthetics.

14. Induction room

A room, other than where the surgery is performed, in which to administer anesthetics.

15. Recovery room

A special area for intensive nursing care to be given to patients who are recovering from an anesthetic.

16. Workroom

A room within the immediate operating-room area for the preparation and sterilization of instruments, linen, and supplies for use in surgery.

17. Service case

A patient who has charity or partial charity status and whose surgery and anesthetic administration are performed by the house staff.

18. Room-ready time

The time used to clean up an operating room after the completion of an operation, plus the time to set up for the next case if one is to follow.

Criteria

The following criteria were established for the study to allow consistency and, consequently, meaningful observations and data:

1. A room must be capable of supporting the full gamut of general surgical operations to be considered as an operating room.

2. Any definitive procedure performed in an operating room, by choice or common practice, is to be counted as an operation.

3. Any operative procedure, regardless of its nature, is to be accepted as an emergency if so scheduled by the surgeon.

4. Any procedure not termed an emergency by the surgeon is to be considered elective surgery, whether or not it is accomplished during the normal daytime schedule.

5. An operating room which is being cleaned or set up for an operation is to be considered in use even though no

patient is present.

6. An empty operating room is to be regarded as unused when it is ready to receive a patient.

7. Operating-room disuse due to delays, cancellations, or nonscheduling is to be recorded as nonutilized time when it occurs during the regular 8:00 A.M. to 5:00 P.M. hours.

8. Operating-room vacancies of ten minutes or less are considered within reasonable and necessary bounds and are not to be included as nonutilized time.

9. Only Mondays, Tuesdays, Wednesdays, Thursdays, and Fridays are to be accepted as normal days for the surgical schedule.

10. Since there is no operating-room closure for lunch, the hours from 8:00 A.M. to 12:30 P.M. are to be regarded as morning and 12:30 P.M. to 5:00 P.M. as afternoon.

11. The main criterion for judging the effectiveness of utilization of the operating room is to be the percentage of the regular scheduling hours used.

12. The difference in room utilization between the lightest and heaviest days is to be a major criterion for judging the variability of operating room schedules.

Standards

For the purpose of this study, the conventional eight-hour day for nursing service personnel is accepted as a standard. Since surgical procedures differ widely in nature, there is no standard allotment of time to accommodate every type of operation, nor is there a set number to be performed in a day. Fixed, quantitative standards for operating room utilization or schedule variability are not existent. Each institution, in accordance with its mission and resources, must have its own acceptable levels determined.

In considering alternatives for a solution to this problem, some established principles and methods of scheduling are examined. In addition, as part of the proposed solution to the problem, some old rules, good as ever, are applied in formulating sound operating-room policies and regulations. Such guidelines may be considered standards within the greater sense of the word.

Literature Review

Evaluation of operating-room scheduling touches upon many other areas. London suggested the following considerations:

1. Is expansion or reduction of the rooms indicated?

2. How does the operating-room workload vary?

3. How much time is spent preoperatively, on the surgery, and on the cleanup?

4. How much time is used to transport patients to and from the operating room?

5. Does the layout allow for flexibility in scheduling differing procedures?

6. Do the operating-room regulations adequately state: (a) policy for assigning time and rooms, (b) the incision time for lead-off cases, (c) when the surgeon is to arrive in the operating room, (d) what time the schedule is to be closed?

7. Is there a waiting list even when some operating-room time is free?

8. Could daily variability in usage be reduced?

9. What steps could eliminate delays from the wards?

10. What co-ordination exists with housekeeping personnel to clean the rooms?

11. How prompt are laboratory and X-ray reports?

12. Is there a formal arrangement to cancel scheduled

cases?[3] Not only the procedure of scheduling, but also the above considerations are involved in solving scheduling problems.

Of the total daily period available for surgery, it is necessary to determine what portion of time is unused. Operating-room time should be considered unused only when a room is fully prepared for surgery. Used time, on the other hand, includes periods when a room is dirty or being cleaned, as well as when it is occupied by a patient undergoing anesthesia, preparation, surgery, or resuscitation. The biggest losses of operating-room time, listed in the order of their magnitude, were found to be nonscheduled periods, cancellations, and delayed starts.[4] Scheduling by allotting certain operating rooms or certain days to each of the various surgical specialty services contributes to unused time. When one service fails to use its time, it is often not made available to others soon enough to schedule their cases.

Central scheduling has been offered as a way to

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[3]Morris London, "Know Your O. R. Vacancy Rate to Improve Surgical Scheduling," The Modern Hospital, CIII (October, 1964), 113-14.

[4]Otto C. Zimmerman, "Utilizing Operating-Room Time," Hospital Topics, XLI (February, 1963), 102.

control the variability between available and utilized operating-room time.[5] In this method, all services have equal daily access to all operating rooms through a single scheduling agency. Close co-ordination with the admitting office is desirable to align available surgical beds with free operating-room time.[6] Accuracy of scheduling is enhanced by having the surgeon give an estimate of the time he needs for an operation and then keeping a record of the actual time to help future estimates.[7]

There is a tendency for operating rooms to be overworked in the mornings and underworked in the afternoons.[8] A better balance and more surgery are possible by scheduling throughout the day. Occasionally, surgeons even discover

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[5]Davis and Reed, p. 115.

[6]Ralph F. Miller, "Scheduling Surgery," Hospitals, XXXVII (February 16, 1963), 29.

[7]Ernest T. Sheen, "A Realistic Surgery Schedule Based on Surgeon's Own Estimates," Hospitals, XXXVII (November 1, 1963), 50.

[8]Alice R. Clarke, "Challenging New Study Made of Traditional O. R. Practices," Hospital Topics, XXXVIII (March, 1960), 86.

that afternoon surgery proves best for them.[9] Some hospitals have uniformly well-utilized operating rooms during the weekdays but are still unable to meet demands. The seven-day work week helps in such cases.[10]

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[9]Hugh A. Johnson, "Why Not More Afternoon Surgery?," Medical Economics, XLII (July 26, 1965), 235.

[10]Robert Y. Garrett, Jr., "Seven-Day Work Week Improves Service," The Modern Hospital, CIII (November, 1964), 114-15.

CHAPTER III

APPROACH TO THE PROBLEM

The approach to the problem was to collect statistical data in the North and South Surgeries in order to quantify the degree of the variability in the operating-room schedules. The causes of the variability were to be determined through the employment of operating-room data to be collected, direct observations within the hospital, and interviews with selected personnel.

The Eye Surgery was excluded from the study principally for two reasons. It was not capable of supporting general surgical operations and it was to remain physically separated from the other operating rooms in the new building. Furthermore, it was served by a relatively small number of nursing service personnel who manned outpatient clinics for the eye service as well as its operating room.

Data from South Surgery

A modification of Shindell and London's form for collection of data on operations was adopted (see Appendix

A).[1] A separate dated sheet was used daily for each of the nine operating rooms for a continuous thirty-day period, March 20, 1967, to April 18, 1967, inclusively. The starting date was not specifically selected in advance but simply was the time when the printer happened to deliver the blank forms.

On a sheet for each room the circulating nurse entered the name of the operation to be done and whether or not it was an emergency. She then recorded the hour and minute that: (1) the operation was scheduled to begin, (2) the patient entered the room, (3) the anesthesia began, (4) the surgery was completed, and (5) the room was ready for reuse. Reasons were to be given for delays of ten minutes or longer and also for cancellations. In the mornings, the South Surgery clerk verified that operations having taken place during the night had been documented. The secretary to the assistant administrator in charge of nursing services then collected the sheets and held them.

In using the data, delays or room vacancies of ten

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[1]Sidney Shindell and Morris London, A Method of Hospital Utilization Review (Pittsburgh: University of Pittsburgh Press, 1966).

minutes or less were disregarded while those of greater length were included in their entirety as nonutilized time. Because daily surgical schedules varied in heaviness, only completed Monday through Friday periods were taken for study. The weekends were segregated because of limited surgery. Therefore, when not specifically stated otherwise, the data to follow refers only to week days. At St. Anthony Hospital the hours between 8:00 A.M. and 5:00 P.M. were considered to be satisfactory for scheduling elective surgery. Therefore, the calculation of nonutilized operating-room time was limited to that period. For purposes of this report, day was 8:00 A.M. to 5:00 P.M., morning was 8:00 A.M. to 12:30 P.M., and afternoon was 12:30 P.M. to 5:00 P.M.

The data were utilized in the following ways:

1. The number of minutes of operating-room vacancy due to the combination of operation cancellations and unscheduled periods of more than ten minutes in duration was determined for the morning, the afternoon, and the entire day.

2. Periods of vacancy due to cancellations and nonscheduling were categorized by length and were tabulated according to frequency of occurrence.

3. The total daily loss of time caused by delays of more than ten minutes was arrived at by adding the duration of delays due to late operating room entry of the patient to the time lost through late starts of anesthesia. When a patient was moved into a room ahead of schedule, resulting in a lapse of more than ten minutes until the start of anesthesia, the time loss was not credited as a late anesthesia start unless anesthesia began more than ten minutes after the originally scheduled time of the operation. If anesthesia did begin as originally scheduled, the unutilized time was charged as a loss through nonscheduling.

4. The number of delays and how many of them were of thirty minutes or more in length was determined.

5. The stated causes of delays of ten minutes or longer were totaled by types.

6. Adding the vacancy time caused by cancellations and nonscheduling to the time loss from delays gave the total nonutilized time for the 8:00 A.M. to 5:00 P.M. day.

7. The amount of utilized time was found by subtracting the daily nonutilized time from the available time.

8. Variability was further demonstrated by calculating the percentage of utilization for the days with the

greatest, the least, the mean, and the median utilization.

9. Further information extracted was the total number of operations and the number of emergencies.

10. It was calculated how much operating-room time was used outside of the regular hours by emergency and also by nonemergency surgery.

11. The average time to ready (clean up, set up) a used room for surgery was determined.

Data from North Surgery

The only useful data available for North Surgery was that which was routinely kept on charge slips. It consisted of the time of day that the anesthesia induction began for each operation and the time the patient was wheeled out of the operating room after surgery. By adding an average room-ready (clean up, set up) time, as determined from the South Surgery data, the total useful operating-room time taken for each operation could be calculated.

Emergency operations were not identified as such in the records. They were recorded identically to the elective ones. Data were collected only for the operations done in the four rooms which were suitable for general surgery. Consequently, the cystoscopic room could not be included, nor

could the three cast rooms. Furthermore, the procedures done in the cast rooms were never timed.

The data collected in the four North operating rooms were as follows:

1. The total time consumed by operations during the regular day-time hours was computed, and further broken down into that for the morning and the afternoon hours.

2. Variability in usage during the daily regular hours was further demonstrated by calculating the percentage of utilization for the days with the greatest, the least, the mean, and the median utilization of the 8:00 A.M. to 5:00 P.M. period.

3. The total number of operations was extracted as well as the number done fully or partly outside of the regular 8:00 A.M. to 5:00 P.M. hours.

4. Determination was made of the amount of time used for operations outside of the regular hours.

5. The sum of the operating-room time used during the regular hours and that used outside of those hours equaled the utilization for a twenty-four-hour period.

Further Data Applications

Trial rescheduling

It was intended to see how much of the surgery done after 5:00 P.M. or before 8:00 A.M. could have been fitted into the approved daytime hours. If all of it did fit into the regular day-time schedule, the effect on operating-room utilization was to be quantified. Of course, some of the emergency surgery had to be done at odd hours. Therefore, on South Surgery, of the operations which took place after-hours, only the nonemergencies were subjected to trial calculation into the daytime schedule.

On North Surgery, however, emergencies were not identified and they had to be included in the testing. Consequently, they inflated the trial utilization figures slightly since the entire utilized time for a twenty-four-hour period was fitted into the regular daytime hours.

All daily figures for the twenty week-days were totaled and averaged. The averages of the utilized operating-room time were to provide guidance as to the number of rooms and hours to be scheduled in the future.

Nursing personnel costs

Since North Surgery nursing personnel also worked in the cystoscopic room and on the untimed cast-room procedures, it was not possible to determine from available data what

percentage of their time was spent in the four operating rooms. Therefore, exact costs were not obtainable.

For South Surgery, however, the information made available for the twenty weekdays in the study included the total labor costs and man hours worked. It was broken down for the different types of employees as follows: registered nurses, licensed practical nurses, scrub technicians, ward clerk, nurse aides, and orderlies. The above totals included overtime, but overtime costs for the period were also available separately. With this information, the average hourly rate per type of job and the average total daily labor cost for South Surgery were obtainable.

The above costs were intended for comparison with the costs of any new staffing arrangement which might be suggested by the study. A breakdown of costs by shifts worked was not of use since the 8:00 A.M. to 5:00 P.M. week-day hours were covered by eight different staggered, overlapping shifts and four additional ones worked by part-time personnel.

Weekends

Since there were to be no elective operating-room procedures on Saturday afternoon and Sunday, and since they

were stringently restricted on Saturday mornings, there was no comparison of weekend schedules with those of weekdays. Variability of utilization caused by emergency operations on weekends was not considered subject to control by ordinary scheduling. It was recognized, however, that with the normally light weekend staffing of the operating rooms, emergencies are less easily absorbed than on fully-staffed week days. Therefore, primarily as background for staffing guidance, data were derived from four consecutive weekends to show the average weekend load.

Observations and Interviews

For the purposes of the study, St. Anthony Hospital was visited on January 23 and 24, 1967, and from May 1 to 10, 1967. During these periods, observations were made within the operating rooms and in other areas of the hospital having related functions. Personal interviews were conducted during both periods.

The following persons were interviewed repeatedly and contributed much to the study: The Assistant Administrator in charge of the Nursing Services, the Director of the Nursing Service, the operating-room supervisors of both North and South Surgery, and the other nursing service

personnel assigned within the operating rooms. Additional St. Anthony Hospital personnel interviewed were: The Administrator, the Associate Administrator, the Assistant Comptroller, the Assistant Supervisor of the Central Supply Service, the Supervisor of the Admissions Office, the Chief of the Surgical Service, and the Chief of the Anesthesia Service.

At Mercy Hospital in Oklahoma City, the Assistant Administrator and the Chief of the Anesthesia Service were interviewed for background information regarding the functioning of the group of anesthesiologists who confined their services to that single hospital.

Limitations

The limitation of the operating-room statistical data to a four-week period was not considered unduly prejudicial. Taking the number of operations which were done over four weeks, Davis and Reed could predict the number of future procedures with reasonable accuracy.[2] There was a physical inhibitor in the study in that surgery in this hospital was done in three separate and autonomous operating-room complexes.

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[2]Davis and Reed, p. 114.

Although special statistical data were collected from South Surgery, only the limited, routinely-kept records were available from North Surgery. Eye Surgery was not included at all.

Another limitation was that the investigator could not be on the scene during the four-week statistical data-collection period. The special forms used had to be filled out by personnel indigenous to the operating room without frequent supervision. As a result, several places for information on the form were not fully satisfied. There were frequent failures to record the causes of delays. An error eventually corrected was the misinterpretation of the blank entitled "Room Ready." After the average room ready time was determined from the blanks which were filled in correctly, it was used as a substitute for those which were misinterpreted.

CHAPTER IV

PRESENTATION AND DISCUSSION OF DATA

South Surgery Statistics

With the available data, time lost through cancellations could not be distinguished from that due to nonscheduling. The operating-room personnel were rarely able to discover the reasons for cancellations and did not record the few they did learn. For the nine rooms combined, the daily average of vacancy time from these two causes was 2,984 minutes amounting to 61.4 per cent of the available time between 8:00 A.M. and 5:00 P.M. Of this nonutilized time, an average of 1,312 minutes, equaling 44.0 per cent, was in the mornings, a time of day normally expected to be heavily scheduled.[1]

In the breaking down of the vacant periods according to morning or afternoon occurrence, those involving 12:30 P.M. were divided into two portions, morning and afternoon. This division caused the number of short periods of time to increase slightly at the expense of the longer ones.

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[1]Clarke, p. 86.

Nevertheless, it proved that the longer periods were more numerous than the shorter ones (see Table 1).

TABLE 1

AVERAGE DAILY NUMBER OF VACANCIES DUE TO CANCELLATIONS AND NONSCHEDULING TABULATED BY LENGTH OF TIME AND TIME OF DAY

Duration of Vacancy	Morning	Afternoon	All Day
11-29 minutes	1.6	0.7	2.3
30-59 minutes	2.5	1.3	3.8
60-119 minutes	4.8	2.2	7.0
120 minutes and over	4.5	6.4	10.9
Total	13.4	10.6	24.0

Many in the longest category were over three and four hours in duration. This information indicated that there had been many periods of ample length to schedule any type of operations (see Appendix B). As a matter of fact, in the twenty weekdays surveyed, there were 218 vacancies in the "120 minutes and over" category, averaging 10.9 in daily number and ranging up to four and one-half hours in length.

Trying to move up operations at the last minute to fill in vacancies in the schedule seemed of little value.

Even if the nursing personnel were available, the surgeon and anesthesiologist would have had to be located and free. In addition, to gain anything, subsequent operations would also have had to be moved up. Cancelled and nonscheduled time was of little use except for emergency surgery and the performance of routine operating-room chores.

Delays proved a significant but less formidable cause of operating-room time loss. The average daily time loss due to delays between 8:00 A.M. and 5:00 P.M. was 170 minutes. Delays in patients entering operating rooms accounted for 60 minutes of that loss, while delays in starting anesthesia were responsible for 110 minutes.

It was often assumed that delays of patients in entering the operating rooms were caused by the nursing units. In reality, however, some such delays were caused by late surgeons and anesthesiologists. When forewarned of such late arrivals, the nursing-service personnel would have the patient wait on the ward rather than in the operating room.

Delays in starting anesthesia were caused by surgeons as well as anesthesiologists. The anesthesiologists would normally withhold the anesthetics until the surgeon had arrived in the hospital. This is practical since modern

anesthetic induction usually takes a brief time.

Of the 144 delays recorded during the period studied, 34 exceeded one-half hour in length. On the other hand, of the 480 nonutilized periods due to cancellations and nonscheduling, 434 exceeded one-half hour in duration. Therefore, cancellations and nonscheduling were responsible for 92.7 per cent of all nonutilized periods of thirty minutes or longer. This was consistent with the findings of others.[2]

The causes of delays were, nevertheless, of interest (see Table 2).

TABLE 2

CAUSES AND FREQUENCIES OF DELAYS OF 10 MINUTES OR LONGER DURING 20 WEEKDAYS

Cause	Frequency
Patient late	8
Patient not properly prepared	14
Patient not premedicated	1
Special preparation needed	2
Patient's personal problems	0
Laboratory studies missing	3
Room not available	8
Nurses not ready	6
Anesthesiologist late	48
Anesthesia difficulties	10
Surgeon late	39

As was stated before, reasons were not given for all delays.

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[2]Zimmerman, p. 100.

Sometimes several of the delays listed above occurred on the same case. It could be seen, however, that late anesthesiologists and late surgeons were clearly the most commonly-indicated causes of delays.

Adding the South Surgery time loss caused by delays to the vacancy time due to cancellations and nonscheduling yielded a daily average of over 52.5 hours (3,154 minutes) of nonutilized operating-room time between the hours of 8:00 A.M. to 5:00 P.M. Of this wasted time, 94.6 per cent was caused by cancellations and nonscheduling and only 5.4 per cent by delays. Even so, the sum of the delays averaged nearly three hours daily.

With a daily total of 4,860 minutes available for use from all nine rooms combined, it was seen that a daily average of 1,706 minutes were gainfully used, giving an average daily utilization percentage of 35.1 per cent. Daily utilization ranged between 21.6 per cent and 63.7 per cent, a marked degree of variability (see Table 3 and Appendix C).

The average number of operations performed per twenty-four-hour period was 27. For the same time, the emergency operations averaged 2.3 (see Appendix D). Some of them were done during the day. As for the 240 minutes of operating

TABLE 3

PERCENTAGE OF UTILIZATION FOR SOUTH SURGERY BETWEEN 8:00 A.M. AND 5:00 P.M.

Day	Utilization
Lightest Day	21.6%
Heaviest Day	63.7%
Mean Day	35.1%
Median Day	33.5%

done outside of the 8:00 A.M. to 5:00 P.M. hours on an average day, the emergencies, at 93 minutes, consumed considerably less time than the electives. In spite of the low operating-room utilization during regular hours, a daily average of 147 minutes, nearly two and one-half hours, of elective surgery was being done outside of those regular hours.

If that portion of surgery had been done within the regular hours, a small improvement would have resulted in the average daily utilization but not in the variability (see Table 4). Operating-room staffing would have benefitted, however, by the reduction in evening surgery.

The average time to clean up and set up a room between operations was found to be 9.8 minutes. This figure was obtained by averaging 364 stated room-ready times. For

TABLE 4

TRIAL UTILIZATION PERCENTAGES FOR SOUTH SURGERY AS IF ALL NONEMERGENCY SURGERY HAD BEEN DONE BETWEEN 8:00 A.M. AND 5:00 P.M.

Day	Utilization
Lightest day	22.1%
Heaviest day	65.6%
Mean day	38.0%
Median day	35.3%

use, it was rounded off to ten minutes. When a room was left idle after an operation or when no ready time was stated, ten minutes were added to the operative time to calculate utilized time. The ten-minute average ready-time was also used to calculate North Surgery utilization figures.

This average time of ten minutes was rather short by some standards. In some hospitals fifteen to forty minutes were consumed.[3] The time was apparently reduced in this study by the practice of setting up simultaneously for as many as three operations to follow one another in the same

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[3]Joseph K. Owen (ed.), Modern Concepts of Hospital Administration (Philadelphia: W. B. Saunders Co., 1962), p. 213.

room with the same surgeon. Then, too, a small amount of room cleaning occurred before a patient left an operating room, and some setting up occasionally occurred during the anesthetic induction. These latter activities were not reflected in the average room-ready time.

North Surgery Statistics

Between 8:00 A.M. and 5:00 P.M., the average daily utilized time for the four operating rooms in North Surgery was 749 minutes. Of this time, 447 minutes, equaling 59.6 per cent, was used in the morning. The variability in utilization proved to be even greater than in South Surgery (see Table 5 and Appendix C).

TABLE 5

PERCENTAGE OF UTILIZATION FOR NORTH SURGERY BETWEEN 8:00 A.M. AND 5:00 P.M.

Day	Utilization
Lightest day	16.7%
Heaviest day	62.3%
Mean day	34.6%
Median day	36.4%

For the twenty-day period, an average of 9.9 operations

were done each twenty-four hours. Of these, a daily average of 0.9 operations extended partially beyond or took place fully outside of the 8:00 A.M. to 5:00 P.M. hours (see Appendix D). They consumed an average of 45 minutes daily outside of those regular hours. This figure added to the surgery done during regular hours gave an average utilization of 794 minutes per twenty-four hours.

As was stated before, in North Surgery it was not known how many of the operations were emergencies; therefore, they were included in the subsequent calculations. To test the effect on the utilization percentage, the time used for surgery outside of regular hours was added into the 8:00 A.M. to 5:00 P.M. period (see Table 6). As can be seen, a small improvement occurred in the utilization percentages.

TABLE 6

TRIAL UTILIZATION PERCENTAGES FOR NORTH SURGERY AS IF ALL SURGERY HAD BEEN DONE BETWEEN 8:00 A.M. AND 5:00 P.M.

Day	Utilization
Lightest day	16.7%
Heaviest day	66.3%
Mean day	36.7%
Median day	37.6%

Further Applications of Data

Trial rescheduling

Up to this point, computations were performed separately for South Surgery and North Surgery. It had been hoped that recalculating all available surgery as if it had been done within the preferred 8:00 A.M. to 5:00 P.M. period would result in much improved percentages of utilized operating-room time. Since that was not the case, all available surgery, done in both North Surgery and South Surgery was calculated into the 8:00 A.M. to 5:00 P.M. period for the nine rooms of South Surgery alone. (All operations were included except emergencies done on South Surgery outside of the 8:00 A.M. to 5:00 P.M. hours).

This trial resulted in a marked improvement in the percentages of utilized time (see Table 7). The mean and median days gave a good idea of what the daily utilization percentage would have been for this arrangement if the variability were eliminated.

In the search for simplified staffing and even better utilization, a seven and one-half hour operating schedule for only eight of the rooms was calculated. It provided a 73.5 per cent mean utilization. (Counting the ninth room it

TABLE 7

TRIAL UTILIZATION PERCENTAGES AS IF ALL SURGERY DONE IN BOTH NORTH AND SOUTH SURGERY HAD BEEN DONE IN THE NINE ROOMS OF SOUTH SURGERY ALONE BETWEEN 8:00 A.M. AND 5:00 P.M.

Day	Utilization
Lightest day	38.6%
Heaviest day	76.6%
Mean day	54.4%
Median day	53.3%

would have been 65.3 per cent.) Additional safety factors against understating utilization were the ten-minute grace periods allowed before designating time as nonutilized on South Surgery and the slight inflation of the daytime utilization percentage by inclusion of unidentified night emergencies from North Surgery.

Nursing personnel costs

For the twenty weekdays studied on South Surgery, the average daily cost for nursing service personnel was $461.66. This figure included the average daily overtime payments which were a modest $8.54 encompassing all personnel. It did not include home night-call expenses.

During the surveyed period, the following personnel

worked in South Surgery: (1) nine nurses, including two part-time, (2) five licensed practical nurses, including one part-time, (3) eighteen surgical technicians, including two part-time, (4) one ward clerk, (5) three nurse aides, and (6) one orderly. The average man hours worked and average personnel costs per day for South Surgery were broken down according to the six categories of employees (see Appendix E). The average hourly rate (including overtime) was also calculated for each category.

During the same period North Surgery employed: (1) five nurses, (2) seven surgical technicians, (3) one ward clerk, (4) one nurse aide, and (5) three orderlies. Because of the mixed duties, it was not possible to determine exact nursing personnel costs for running the four operating rooms in North Surgery. Nevertheless, based on the number of employees, an eight-hour day, and the average hourly wage rates (average wage rates as determined for South Surgery were used), the average daily personnel costs for North Surgery were approximately $262.72. The total for both surgeries was, therefore, approximately $724.38. For the purposes of this study, the cost for nurse aides ($48.71 per day) will be deducted, leaving $675.67 as the average daily total personnel cost and

$18.31 as the average personnel cost per operation (see Appendix E).

The elimination of nurse aide costs will be necessary for purposes of comparing the personnel costs of the four weeks studied with those of the alternatives proposed as solutions to the problem. Aides will not be included in any of the proposed operating-room staffings, since the services they render should be performed in central supply. Because of the transposition, rather than true elimination, of the expenditure for aides, it would be prejudicial to include it among the operating-room personnel costs of the study period.

The hospital accounting practices did not include the costing of utilities or other support, such as engineering services; therefore, total operating-room costs could not be determined. Furthermore, for the following reasons, no data were collected on the cost of operating-room supplies and their preparation: (1) a complete cost study of central supply would have been necessary, (2) it was not possible to determine the amount of supplies which were consumed only on weekdays, and (3) regardless of what scheduling changes might be proposed, they would not result in any increase or decrease in the amount of supplies required for each operation

performed. In this study, therefore, the daily operating-room costs and the average cost per operation can be expressed only in terms of the costs for nursing service personnel.

The supervisor of South Surgery was a Catholic Sister who received no salary. Consequently, none of the solutions to be proposed will include any cost for that position.

Weekends

Elective surgery on weekends was restricted to Saturday mornings. Normally, North Surgery ran only one room for electives and South Surgery ran two or three. In South Surgery there was an average of 3.5 emergency operations on Saturdays and an average of one on Sundays. The procedures scheduled tended to be relatively minor ones since the house staff was in conference at that time and was not available to assist at operations. For the remainder of the weekend, the nursing service staffed the operating rooms lightly, and a few additional personnel were placed on home call.

Data derived from four consecutive weekends are included as an appendix to provide background and staffing guidance (see Appendix F).

Additional Observations

As the foregoing information documented and quantified

the variability in St. Anthony Hospital operating-room schedules, it became clear that the large amount of time available for scheduling was a major contributor to the low percentage of utilization and, in turn, to the variability. With so much accessible time, operations were bound to be scattered about in haphazard fashion.

Much of the material obtained through direct observations and interviews was given in the preceding portions of this report. Nevertheless, additional information was useful in clarifying the causes of the variability in schedules. On the positive side, St. Anthony Hospital, in spite of some old portions in its plant, is a modern, fully-equipped, and up-to-date institution. In general, that statement applies to the operating rooms as well. The following comments, however, are not intended to recite the many good features but to point out things which were related to the problem.

Registered nurses were in rather short supply, but compensation was made through the hiring of licensed vocational nurses and scrub technicians. This practice is a common and approved one.[4] There was no problem in obtaining sufficient quantities of such personnel. They worked an

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[4]Ibid., p. 215.

eight and one-half hour shift because the half hour for lunch was not paid time.

In North Surgery the nursing service personnel, as previously stated, spent an unmeasured portion of their time assisting in the cast rooms. Such procedures were all unsterile and were largely cast changes and closed reductions, most of which would be done in the outpatient department in many hospitals. Some of the staff considered the cast-room functions distracting and undesirable to mix with the activities of the operating room. Furthermore, the mixing caused an unknown amount of personnel costs for orthopedic clinic-type work to be borne by the operating room.

Neither of the Surgeries had anesthesia induction rooms. The lack caused no great problems because inductions, in general, have been quite rapid in recent years. Two of the operating rooms on South Surgery had rather poor lights. The rooms were used when needed, but other rooms were favored. Storage space was limited in both Surgeries; consequently, cabinets had to be used to store supplies in some of the operating rooms.

No excessive difficulty was experienced in receiving patients on time from the nursing units. Preoperative procedures were recorded on a check list. This practice saves

time and prevents errors.[5] File cards with each surgeon's instrument preferences for various operations speed set-ups.[6] South Surgery employed such a device.

In the time between operations, the nursing personnel prepared and wrapped supplies and instruments for autoclaving. The workroom on South Surgery was located a full 85 feet from the nearest operating-room. Workroom space was quite limited, and instruments piled up alongside of the only instrument washer. Linen preparation took up most of the area. In spite of the overcrowding, apparently few delays occurred through lack of prepared supplies. Nevertheless, there was little reserve capability. If operating-room utilization had been increased, much additional materiel could not have been prepared within the workroom.

South Surgery prepared all of its own instruments and supplies except gloves, while North required outside support for gloves and linen packs. This support was given by central supply, an activity which even though limited in space,

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[5]Thomas J. Gagnon, "Surgery Check List Saves Many Hours of Personnel Time," Hospital Topics, XLIII (September, 1965), 118.

[6]Owen, p. 214.

was minimally staffed after the day-shift ended. With proper night personnel it should have been able to do the Surgical packs for South Surgery as well as North. (This function was planned for central supply in the new building.)

Except for its duplication in both surgeries, the mechanics of the scheduling process were not unusual. Nevertheless, control, by clearly-defined regulations and policies, was lacking. In addition, the pages of the scheduling book were crudely penciled and difficult to read. Unless it was the very day for which the surgery was scheduled, cancellations were made by erasure without any record.

While on duty from 7:30 A.M. to 4:00 P.M., the ward clerk was supposed to do the scheduling, but other people were observed doing it even when she was available nearby. Those who scheduled a case often failed to initial the page in spite of a rule to do so. By day, only registered nurses were to substitute for the ward clerk, but at night scrub technicians would accept bookings. One operation requiring about two hours had been allowed thirty minutes by such a person. The length of time required for the operation being scheduled was not given. The ward clerk stated that she did not usually ask doctors' secretaries how long surgery would

take because they seldom knew.

There was no cut-off time for any of the schedules. Booking continued right into the very date of the schedule. Surgery was commonly accepted for scheduling at earlier hours than the desired 8:00 A.M. The most frequent users of early time were the gynecological and ear, nose, and throat services. Conversely, late scheduling allowed operations to extend beyond 5:00 P.M.

There was no waiting list for beds or surgery. Surgical beds were flexible among the specialties and were freely borrowed and lent among most of the services. On May 8, 1967, beds for major surgery were available as follows (with operating-room booking also available for the day after admission): (1) general surgery on May 11, (2) orthopedic surgery on May 10, (3) gynecological surgery on May 14, and (4) eye surgery on May 14.

Surgeons customarily called the admissions office for a bed as their first step toward arranging surgery. Some then called the operating room to book the surgery, while others booked the anesthesiologist before the operating room. The latter group was the hardest to schedule for operations since they had to ask for the specific time of their

anesthesia booking. The former group, while easier to schedule for, presumably then had more difficulty in finding an anesthesiologist. Sometimes rescheduling was necessary.

Providing anesthesia apparently was a real problem and contributed to the schedule variability. Unfortunately, its effect was not measurable in this study. It would have been desirable to know how many cancellations or refusals of offered schedule time were caused by unavailability of anesthesiologists. The house staff gave anesthesia only to service cases. These were relatively few in number, and fortunately so, for only one intern served on the anesthesia service each month.

One group of anesthesiologists confined their services to a nearby hospital. They felt that they provided better coverage with fewer anesthesiologists. The surgeons were able to schedule operations without having to locate an anesthesiologist. The latter also felt it to be far more economical of their time, since they did not have to run from hospital to hospital.

Whatever the justification, it appeared that surgeons expected to be able to schedule operations to suit their precise convenience, and the operating-room personnel

were obliging them to the greatest possible extent. One day in May, during the study, a surgeon called at about 1:30 P.M. to schedule a herniorrhaphy for the next morning. He stated that the hernia had been incarcerated but had been reduced without strangulation. There was no opening in the schedule for the next morning, but he was offered a booking for the very afternoon he called or one for 2:00 P.M. on the following day. Instead, he chose to schedule the operation at 8:00 P.M. that same night.

By unfortunate coincidence, it developed into the busiest night within recent memory. There was a total of seven operations which added up to 5.7 hours of anesthetic and operative time, not counting two which ran overtime from the day schedule.

No comprehensive written scheduling regulations and policies were seen during the study. The surgical policy book in the office of the Director of Nurses contained only fragmentary ones for both North and South Surgery. The hospital by-laws had a provision regarding late surgeons (none for anesthesiologists), but apparently it was not enforced.[7]

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[7]By-Laws of the Medical and Dental Staff of St. Anthony Hospital, A Corporation, Oklahoma City, Oklahoma, as amended July 1, 1966, n.p.

CHAPTER V

DISCUSSION OF SOLUTIONS

The Alternatives

Three alternatives were chosen as possible solutions. All of them, however, had to be accompanied by the formulation of comprehensive regulations and policies for operating-room scheduling.

Beyond that, the first possibility was to retain the 8:00 A.M. to 5:00 P.M. hours for elective surgery but to improve their utilization by confining all elective operations to those time limits. Both North and South Surgery were to continue to schedule individually.

The second alternative was to have North and South Surgery continue to function separately but to establish a single central agency to schedule for both of them. Their surgical loads would be balanced according to their capacities, and any specialty could use either surgery.

The third possibility was to fully discontinue open surgery in North Surgery and do all such procedures in South Surgery. In any of the above arrangements, an anesthesia

group could be encouraged to form at St. Anthony Hospital to provide continuous service for its operating rooms.

Evaluation of Alternatives

Comprehensive regulations and policies for operating-room scheduling must be adopted. This applies equally and in addition to all other possible changes which might be selected. Not only do such rules have to be established, but they have to be enforced after fully informing all concerned persons.[1]

Accuracy in scheduling is essential. Not only should a prediction of the time needed for an operation be obtained from the surgeon, but a record needs to be kept to help him correct future estimates.[2] It is necessary to establish firm rules as to when the first case of the day is to begin, how soon the surgeon has to arrive, and what time the schedule is to be closed for the day.[3] Blocks of time long enough to accommodate a major operation should not be destroyed by scheduling a brief procedure in their midst. Therefore, when

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[1]Edith D. Hall, "Scheduling Operations," Hospital Management, XCVII (April, 1964), 78.

[2]Sheen, p. 50.

[3]London, p. 113.

necessary for the sake of better time utilization, a surgeon should accept a space a little earlier or later than he has requested. He should not book his anesthesia in advance of the scheduling.

There needs to be a formal arrangement to cancel scheduled cases.[4] With a specific record of cancellations, the resulting loss of time could be measured and controlled through identification of the common causes and frequent offenders. It is necessary to have clearly-defined procedures on how to deal with lateness.[5] These should include rules for anesthesiologists as well as surgeons.

It would be desirable that no more than two schedulers work on any one operating-room schedule. It is necessary to have two of equal skill so that they can relieve one another. When they go off duty for the day, the scheduling of elective surgery should cease until morning. Night emergencies should be scheduled informally by the nurse in charge. As a safeguard, in case both schedulers become ill at one time, the operating-room supervisor needs to have special familiarity

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[4] Ibid., p. 114.

[5] Shindell and London, p. 55.

with the system.

A desirable feature would be a three-way telephone hook-up with the admissions office so that surgeons could schedule operations and reserve beds simultaneously.[6] A further optional mechanical refinement could be a visual control system, such as a wall board or plastic pocket device to represent the blocks of time in which to schedule.[7] The foregoing are all advantageous in establishing proper scheduling rules and procedures.

Including the scheduling improvements just discussed, the first alternative is to continue to schedule individually in North and South Surgery. The 8:00 A.M. to 5:00 P.M. operating-room day would be retained, but all elective surgery would be strictly confined to those hours.

The advantages would be that staffing before 8:00 A.M. and after 5:00 P.M. would be simplified and that utilization of the regular hours would be improved. Unfortunately, picking up the off-hours elective surgery would improve the average utilization percentage by only 2.9 per cent on South

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[6] Ibid., p. 56.

[7] L. J. Atkinson and E. Brazell, "Visual Control System for Scheduling of Surgery," Association of Operating Room Nurses, III (March-April, 1965), 79-82.

Surgery and 2.1 per cent on North.

The obvious disadvantage would be that variability could not be overcome, because there simply is not enough surgery to fill those long hours. The percentage of utilized time could never increase further unless, for some unrelated reason, the amount of surgery would increase. Furthermore, the operative day is too lengthy to cover with one shift of nursing personnel, and it would continue the crazy pattern of staggered, overlapping shifts.

The small financial advantage gained by tightening the schedule would be offset by adding extra ward clerks. Thus, the average daily total personnel cost would be slightly elevated to $680.10 and the average per operation to $18.43 (see Appendix G).

Retaining the other scheduling improvements, the second alternative is to have North and South Surgery continue to function separately but to establish a single scheduling agency to serve both of them. Their surgical loads would be balanced according to their capacities so that their daily schedules would conclude at approximately the same time. With specialties no longer segregated, operations for any service could be scheduled in either surgery.

This system is referred to as central scheduling.[8] Spreading the workload evenly throughout the week, as well as between the two surgeries, would reduce variability. Since staffing has to be based on the maximum daily demand for the week, overstaffing could be avoided.[9] The urgency of the prospective operation must still determine its placement, and any variation in time between its predicted and actual duration should be recorded.[10]

Using central scheduling properly for the same average workload which was performed during the time of survey (including the elective surgery which was done outside of the regular hours), the daily operations in South Surgery could have been completed in 3.4 hours, and those in North within 3.3 hours. These calculations were based on 100 per cent utilization of time. Considering a more credible 75 per cent utilization, South Surgery would have required 4.5 hours and North 4.4 hours.

The advantage of completing the schedule at an early

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[8]Davis and Reed, p. 113.

[9]Ibid., p. 116.

[10]Ibid., p. 115.

hour would be to avoid fatigue and to allow the surgical staff to indulge in other activities, such as teaching and consultations.[11] The disadvantages tie primarily in the nursing personnel staffing. Concluding the operative work by 12:30 P.M. would leave excessive time to fold linen and prepare supplies. Furthermore, central supply workers could be hired at a cheaper rate for that type of work and could do it just as well. Still, unless the nursing personnel would stay around and do menial jobs for the rest of the day, few of them could complete forty hours of duty during a week. Such a practice would eliminate the savings of this proposal. If, however, the majority of the personnel were willing to work only part-time, and if, at 12:30 P.M. when the regular schedule concluded, the staff were reduced to evening levels (two rooms manned), the average daily personnel cost would be $457.22, which amounts to only $12.39 per operation (see Appendix G).

The third alternative is to discontinue open surgery in North Surgery and do all such procedures in South Surgery alone. In addition to retaining the refinements in scheduling

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[11]Vandam, p. 152.

as previously established, this alternative has all of the advantages of central scheduling. Since all bookings would be under unified control and since the surgical workload would be more adequate for the rooms available, variability could best be reduced.

As discussed in the previous chapter under "Trial Rescheduling," this arrangement would have allowed an average operating-room utilization of 54.4 per cent for South Surgery if all nine rooms had been used with the regular 8:00 A.M. to 5:00 P.M. hours. Still using the workload figures of the survey period, but reducing the available time for surgery to seven and one-half hours, the average utilization would have been raised to 65.3 per cent, and if only eight rooms were staffed it would have been an even more attractive 73.5 per cent.

The latter arrangement would simplify staffing. Nursing personnel are required to be in the hospital eight and one-half hours daily since they are not paid for the thirty-minute lunch period. Consequently, if the surgical schedule hours were limited to 8:00 A.M. to 4:00 P.M., the nurses could go on duty at 7:30 A.M. (to set up) and go off at 4:00 P.M. (This plan would provide seven and one-half

hours of actual surgical time since the half hour for setting up and the half hour for lunch would not be counted as available operating time). If cases run later than four o'clock, it would sometimes be possible for the evening nurses to take over in order to keep down overtime costs.

Therefore, as can be seen, the full amount of elective surgery and daytime emergencies handled during the observed period could be done with only one shift of nursing personnel working five days a week. Such an improved situation would allow four of the registered nurses to act as intermediate level supervisors, each monitoring two operating rooms and reporting to the head nurse and the operating-room supervisor. These four nurses would serve as additional buffers for unexpected absentees and emergency operations. (The ninth operating room also provides a buffer for the latter).

Because of the simplified shifts, the above plan would allow the management of all surgery with a smaller number of scrub and circulating types of nursing personnel than were full-time employees in South Surgery during the survey period. The preparation of all surgical packs would be taken over by central supply, thus using cheaper labor and freeing

the operating-room workroom for hardware. Night and weekend coverage would remain unchanged and, without nonemergency surgery, should be ample.

With this alternative, the average daily personnel cost would be $499.20, allowing a daily saving of $176.47, as compared to the $675.67 being spent during the study. The existent average personnel cost per operation would be reduced by $4.79 to become $13.52 (see Appendix G).

The costs slightly exceed those of the second alternative, but the third gives greater depth of supervisory personnel and presents no staffing difficulties.

Orthopedic Surgery's open procedures, never done in cast rooms, were being done in North Surgery operating rooms. Shifting those operations to South Surgery presents no serious problem. The same is true of open genito-urinary surgery. The cystoscopic room presents a different problem. Most nonsurgical cystoscopic procedures could be performed in a clinic. Of the cystoscopics during which endoscopic surgery is done, more than half could be done in South Surgery. The remaining ones, which would require the special cystoscopic table with X-ray, could be handled by setting up the cystoscopic room for several hours biweekly or moving the equipment to South Surgery. The latter problem presents the only

real disadvantage in the third alternative.

A final advantage of this alternative would be that it retains afternoon surgery. There are those surgeons and patients who find the afternoons best for their surgery.[12]

Summary

The problem was to ascertain the causes and degree of the variability in surgical schedules at St. Anthony Hospital and to determine advisable measures for improvement. In the study, particular attention was given to nonutilized time in the operating room. Time lost through delays was considered nonutilized time as well as that lost through cancellations and failure to schedule. Nonemergency surgery done outside of the preferred 8:00 A.M. to 5:00 P.M. hours was evaluated as to its possible inclusion into the regular schedule.

There were two separate operating-room complexes in which major surgery was performed. South Surgery, with nine rooms, accommodated all specialties except the orthopedic, genito-urinary and dental services, which operated in four rooms in North Surgery. A cystoscopic room and three cast

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[12]Johnson, p. 231.

rooms were also in the latter. Eye surgery, done in still another area, was excluded from the study.

In brief, the findings in South Surgery were as follows:

1. The average daily operating-room vacancy time due to the combination of cancellations and nonscheduling filled 61.4 per cent of the available schedule time and constituted 94.6 per cent of the nonutilized time.

2. Nearly half of the above vacancies were two hours or longer in duration and could have accommodated major surgery.

3. Delays in the operating-room schedule consumed an average of nearly three hours daily but amounted to only 5.4 per cent of the nonutilized time.

4. By far the most common cause of delays was lateness of anesthesiologists and surgeons.

5. Marked variability was demonstrated by daily operating-room utilization with a range between 21.6 per cent and 63.7 per cent and an average of 35.1 per cent.

6. Nonemergency operations outside of the regular hours consumed considerably more time than the emergencies.

In North Surgery, where fewer data were available, the findings were:

1. The daily operating-room utilization ranged between 16.7 per cent and 62.3 per cent, with an average of 34.6 per cent.

2. The variability was even greater than on South Surgery.

3. All surgery done outside of the regular hours consumed an average of 45 minutes daily.

4. The operating-room personnel divided their time between sterile procedures in the cystoscopic and operating rooms and unsterile procedures in the cast rooms.

In both South and North Surgery the following were observed:

1. The operating-room personnel spent considerable time preparing supplies in limited working space.

2. There was too little support from central supply.

3. There were deficiencies in the scheduling procedures.

4. There were virtually no well-defined operating-room scheduling policies or regulations, nor were efforts apparent to enforce the few existent ones.

CHAPTER VI

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The findings led to the conclusions that variability of the surgical schedules were severe and that it resulted in inefficient use of personnel and facilities. The lack of comprehensive, enforced operating-room scheduling policies and regulations was the ultimate cause of the variability.

The more immediate causes were:

1. The use of two separate and independently-functioning operating-room complexes.

2. The excessive number of operating rooms staffed for surgery.

3. The excessive length of the daily period for which elective surgery could be scheduled and its contribution to scattered bookings.

4. The resultant nonscheduled vacancies which combined with those due to cancellations to make up the largest block of nonutilized time.

5. The operating-room delays, most frequently caused

by late anesthesiologists and surgeons.

6. The elective surgery performed outside of the preferred 8:00 A.M. to 5:00 P.M. schedule hours.

7. Deficiencies in the scheduling procedures.

All of these factors, as well as an inadequate patient load, contributed to the low percentage of utilization of operating-room time. It was further concluded that all operations done on North Surgery and all nonemergencies on South Surgery could easily have fitted into the 8:00 A.M. to 5:00 P.M. schedule on South Surgery alone, thus bringing the average daily utilization up to 54.4 per cent. Additional improvement would be possible by limiting the scheduling to seven and one-half hours daily and by staffing only eight of the rooms. Nursing personnel could then provide simplified and improved coverage, which would result in an average daily saving of $176.47.

Recommendations

For implementation

It is recommended that:

1. Comprehensive operating-room scheduling policies and regulations, to include modifications in scheduling procedures, be established and enforced (see Appendix H).

2. All open surgery and all feasible endoscopic procedures be done on South Surgery alone, with eight of the nine rooms fully staffed for operations.

3. The routine surgical schedule be from 8:00 A.M. to 4:00 P.M. (seven and one-half hours of surgical time, allowing for a one-half hour lunch period).

4. Four intermediate level supervisors be appointed, each supervising two operating rooms and reporting to the operating-room supervisor or head nurse (see Appendix I).

5. Central supply night operation be increased sufficiently to provide full support to South Surgery including the processing of all surgical packs.

6. Operating-room personnel in the cast rooms be replaced by technicians from the orthopedic clinic.

For further study

It is recommended that further studies be made to:

1. Determine the most common causes of cancellations, the degree of their effect on the surgical schedule, their costs in terms of nursing service salaries paid for nonutilized time, and possible preventive measures.

2. Quantitatively ascertain the effects of anesthesiologists on the surgical schedule, particularly in respect

to their unavailability possibly causing surgeons to cancel or refuse offered schedule time. The possibility of forming an anesthesia group at St. Anthony Hospital is recommended as a subsequent study.

3. Investigate the possibility of transferring the cystoscopy table (with X-ray) to South Surgery.

APPENDIX A

FORM USED FOR SOUTH SURGERY DATA

DAILY OPERATING ROOM REPORT DATE _____

Room No. _____ (Separate sheet for each room daily)

	First Operation	Second Operation	Third Operation	Fourth Operation
Name of Operation or Procedure				
Emergency (Yes or No)				
Enter Time After Each Item Below:				
Operation Scheduled				
Patient Entered Room				
Anesthesia Began				
Surgery Completed				
Room Ready				
Reason for Delays* or Cancellation				

*Use code below for delays of 10 minutes or longer. Describe reason if not listed in code.

1. Patient late
2. Patient not properly prepared
3. Patient not premedicated
4. Special prep
5. Patient's personal problems
6. Lab studies missing
7. Room not available
8. Nurses not ready
9. Anesthetist late
10. Anesthesia difficulties
11. Surgeon late

APPENDIX B

OPERATING-ROOM VACANCIES

TABLE 8

NUMBER OF VACANCIES DUE TO CANCELLATIONS AND NONSCHEDULING DURING FOUR WEEKS OF STUDY

Duration of Vacancy	Morning	Afternoon	All Day
11 - 29 Minutes	32	14	46
30 - 59 Minutes	50	26	76
60 - 119 Minutes	96	44	140
120 Minutes and Over	90	128	218
TOTAL	268	212	480

APPENDIX C

UTILIZATION PERCENTAGES DURING FOUR WEEKS OF STUDY

TABLE 9

UTILIZATION OF SOUTH SURGERY
DURING PERIOD OF STUDY

Date	Time in Minutes		Percentage of Utilization of 4,860 Minutes Available
	Used	Unused	
March			
20	1,111	3,749	22.9
21	3,100	1,760	63.8
22	1,523	3,337	31.3
23	2,153	2,707	44.3
24	2,173	2,687	44.7
27	1,197	3,663	24.6
28	2,382	2,478	49.0
29	1,970	2,890	40.5
30	1,302	3,558	26.8
31	1,298	3,562	26.7
April			
3	1,616	3,244	33.3
4	1,644	3,216	33.8
5	1,687	3,173	34.9
6	1,399	3,461	28.8
7	1,687	3,173	34.9
10	1,050	3,810	21.6
11	2,114	2,746	43.5
12	1,368	3,492	28.1
13	1,882	2,978	38.7
14	1,446	3,414	29.8

TABLE 10

UTILIZATION OF NORTH SURGERY
DURING PERIOD OF STUDY

Date	Time in Minutes		Percentage of Utilization of 2,160 Minutes Available
	Used	Unused	
March			
20	766	1,394	35.5
21	493	1,667	22.8
22	867	1,293	40.1
23	974	1,186	45.0
24	361	1,799	16.7
27	1,063	1,097	49.2
28	780	1,380	36.1
29	812	1,348	37.6
30	413	1,747	19.1
31	459	1,701	21.2
April			
3	852	1,308	39.4
4	795	1,365	36.8
5	864	1,296	40.0
6	814	1,346	37.7
7	1,052	1,108	48.7
10	1,346	814	62.3
11	561	1,599	26.0
12	426	1,734	19.7
13	630	1,530	29.2
14	644	1,516	29.8

APPENDIX D

NUMBER OF OPERATIONS PERFORMED

TABLE 11

NUMBER OF OPERATIONS PERFORMED
DURING PERIOD OF STUDY

Type Operation	Four-week Total	Daily Average
SOUTH SURGERY		
All Operations (day and night)	540	27.0
Emergencies (day and night)	46	2.3
Night Emergencies	26	1.3
Night Electives	72	3.6
NORTH SURGERY		
All Operations (day and night)	197	9.9
Night Operations (emergency and elective)	17	0.9

(Night refers to anytime outside of the regular 8:00 A.M. to 5:00 P.M. schedule hours.)

APPENDIX E

NURSING-SERVICE PERSONNEL MAN-HOURS, RATES, AND COSTS

TABLE 12

MAN-HOURS, COSTS, AND RATES FOR NURSING-SERVICE PERSONNEL OF SOUTH SURGERY DURING FOUR WEEKS OF STUDY

Position	Average Daily Man-hours	Average Daily Cost	Average Hourly Rate	Range in Hourly Rate
Staff Nurse	53.8	$143.25	$2.66	$2.50 - $2.79
L.P. Nurse	28.5	56.78	1.99	1.90 - 2.15
Surgical Tech.	120.3	202.34	1.67	1.60 - 1.90
Nurse Aide	22.0	35.75	1.62	1.50 - 1.75
Orderly	7.5	11.76	1.56	1.50 - 1.75
Ward Clerk	7.6	11.78	1.55	1.50 - 1.90

(The range in hourly rates for central supply technicians was $1.25 to $1.55.)

TABLE 13

MAN-HOURS AND COSTS FOR NURSING-SERVICE PERSONNEL OF NORTH AND SOUTH SURGERY COLLECTIVELY DURING FOUR WEEKS OF STUDY

Number and Position	Average Daily Man-hours	Average Hourly Rate	Average Daily Cost
12 Registered Nurses (plus 2 part-time)	93.75	$2.66	$249.65
4 L.P. Nurses (plus 1 part-time)	28.50	1.99	56.78
23 Surgical Technicians (plus 2 part-time)	176.25	1.67	295.86
4 Orderlies	31.50	1.56	49.20
2 Ward Clerks	15.60	1.55	24.18
Average Daily Total Personnel Costs			$675.67
Average Personnel Cost per Operation[a]			18.31

[a]The average number of operations per day was 36.9

APPENDIX F

WEEKEND DATA

TABLE 14

AVERAGE TIME UTILIZED IN SURGERY ON WEEKENDS[a]

Time Period	Minutes Used	
	South Surgery	North Surgery
Saturday (8:00 A.M.-12:30 P.M.)	299	210
Saturday (All other hours)	272	102
Sunday	162	172
Total Weekend	733	484

[a]Average for four weekends during period of study

TABLE 15

AVERAGE NUMBER OF OPERATIONS ON WEEKENDS[a]

Day	Number of Operations	
	South Surgery	North Surgery
Saturday	9.3	4.3
Sunday	1.3	1.8
Total Weekend	10.6	6.1

[a]Average for four weekends during period of study

APPENDIX G

ESTIMATED PERSONNEL COSTS FOR REORGANIZATION ALTERNATIVES

TABLE 16

ESTIMATED DAILY COST OF NURSING-SERVICE PERSONNEL
FOR THE FIRST ALTERNATIVE
(USING ALL ROOMS OF NORTH AND SOUTH SURGERY)

Number and Position	Daily Man-hours	Hourly Rate	Daily Cost
13 Registered Nurses	104	$2.66	$276.64
23 Surgical Technicians	182	1.67	303.94
4 Orderlies	32	1.56	49.92
4 Ward Clerks	32	1.55	49.60
Average Daily Total Personnel Costs			$680.10
Average Personnel Cost per Operation[a]			18.43

[a]The average number of operations per day was 36.9

TABLE 17

ESTIMATED DAILY COSTS OF NURSING-SERVICE PERSONNEL
FOR THE SECOND ALTERNATIVE
(USING ALL ROOMS OF NORTH AND SOUTH SURGERY)

Number and Position	Daily Man-hours	Hourly Rate	Daily Cost
4 Registered Nurses (plus 9 part-time)	77	$2.66	$204.82
4 Surgical Technicians (plus 16 part-time)	112	1.67	187.04
2 Orderlies (plus 2 part-time)	26	1.56	40.56
2 Ward Clerks	16	1.55	24.80
Average Daily Total Personnel Costs			$457.22
Average Personnel Cost per Operation[a]			12.39

[a]The average number of operations per day was 36.9

TABLE 18

ESTIMATED DAILY COSTS OF NURSING-SERVICE PERSONNEL FOR THE THIRD ALTERNATIVE (USING EIGHT ROOMS OF SOUTH SURGERY ONLY)

Number and Position	Daily Man-hours	Hourly Rate	Daily Cost
13 Registered Nurses	104	$2.66	$276.64
12 Surgical Technicians	96	1.67	160.32
3 Orderlies	24	1.56	37.44
2 Ward Clerks	16	1.55	24.80
Average Daily Total Personnel Costs			$499.20
Average Personnel Cost per Operation[a]			13.52

[a]The average number of operations per day was 36.9

TABLE 19

COMPARISON OF REAL AND ESTIMATED NURSING-SERVICE PERSONNEL COSTS

Circumstance	Average Daily Total	Average per Operation
During four weeks of study	$675.67	$18.31
For first alternative	680.10	18.43
For second alternative	457.22	12.39
For third alternative	499.20	13.52

APPENDIX H

POLICIES AND REGULATIONS FOR SURGICAL SCHEDULING

POLICIES AND REGULATIONS FOR

SURGICAL SCHEDULING

(Proposed for St. Anthony Hospital)

1. With the exception of eye cases and Caesarean sections, all open surgery shall be scheduled and performed on South Surgery exclusively.

2. The hours of 8:00 A.M. to 4:00 P.M. shall be utilized as fully as possible for operating from Monday through Friday, and full staff shall be maintained for eight rooms. No elective surgery may be scheduled outside of these hours.

3. The operating-room supervisor shall have two schedulers only. No one else with the exception of herself shall ever schedule elective operations.

4. Scheduling shall cease at 4:00 P.M. daily, at which time the information shall be transmitted to the admissions offices for duplication and dissemination.

5. The supervisor, the head nurse, or, at night, the nurse in charge, may assign rooms for emergencies as required.

6. A visual, wall-mounted system shall replace the scheduling book. Weeks, days, and hours shall be blocked for scheduling on removable cards.

7. A written record of date, time, and reason shall be made of all cancellations.

8. No large blocks of time shall be bisected by the scheduling of short procedures in their midst. Operations should be scheduled to follow one another closely, with allowances for clean-up time.

9. Each surgeon requesting scheduling must submit an estimate of the time of incision and the start of closure as well as for the entire operation. Diagnosis, complications, and special equipment and personnel needed are required in addition to the name of the procedure to be done.

10. For each operation the operating-room supervisor shall cause an accurate record to be kept of the times of setting up the room, arrival of the patient, start of anesthesia, incision, start of closure, patient departure, and cleaning up. The above information shall be given to the assistant administrator daily.

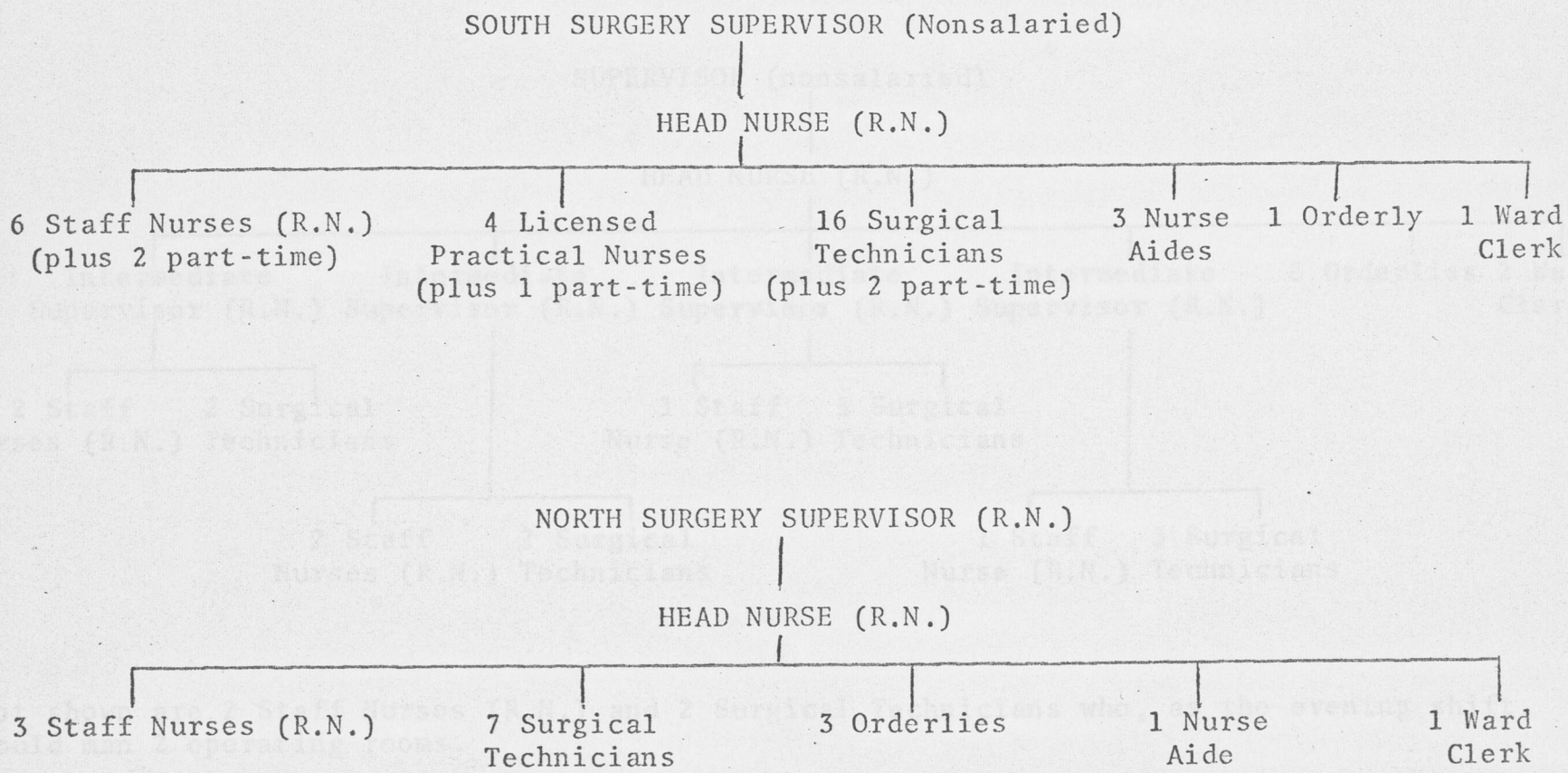
11. The assistant administrator shall compare estimates with actuality, record late arrivals of patients and personnel, including surgeons and anesthesiologists, and report any significant and repeated aberrations to the administrator for disposition.

12. The administrator shall present resulting problems to the president of the executive committee and, if not thereby resolved, to the joint conference committee.

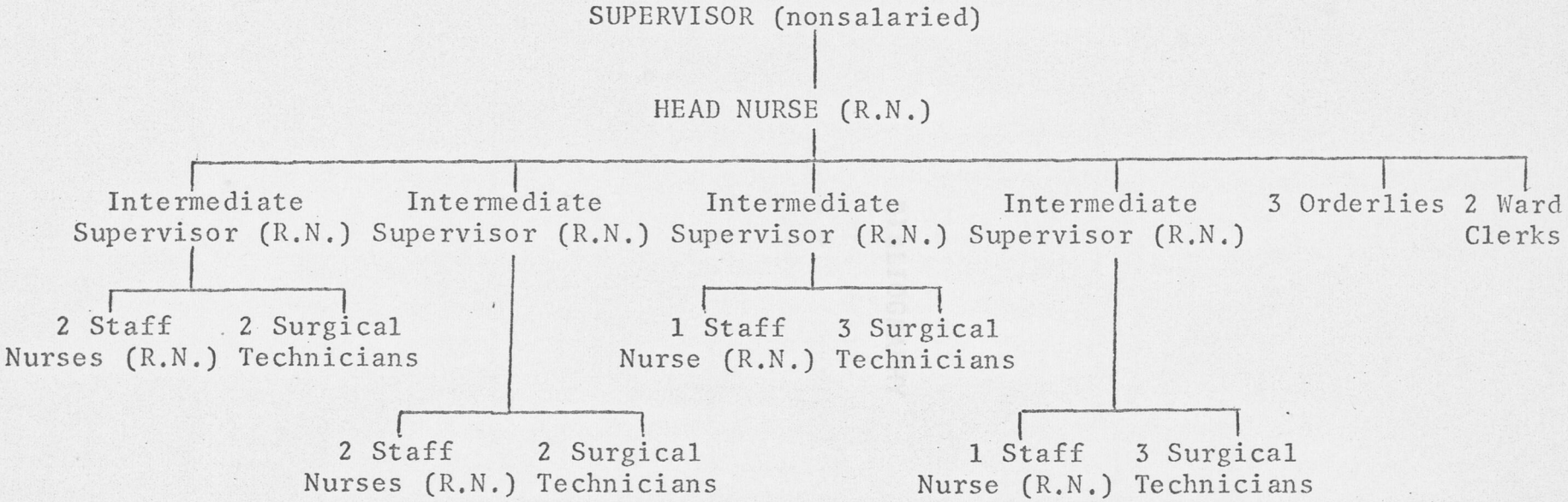
APPENDIX I

ORGANIZATIONAL CHARTS FOR OPERATING-ROOM PERSONNEL

EXISTENT ORGANIZATION OF NURSING-SERVICE PERSONNEL



ORGANIZATION OF NURSING-SERVICE PERSONNEL AS RECOMMENDED FOR SOUTH SURGERY[a]
(OPERATING DISCONTINUED ON NORTH SURGERY)



[a]Not shown are 2 Staff Nurses (R.N.) and 2 Surgical Technicians who, as the evening shift, would man 2 operating rooms.

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ABSTRACT

This paper presents a report on a study of variability in the operating-room schedules at St. Anthony Hospital, Oklahoma City, Oklahoma. Operating-room statistics were collected and on-site observations and interviews were carried out. Great amounts of nonutilized time were found to be due especially to nonscheduling and calcellations.

The variability was marked, and its ultimate cause was considered to be the lack of comprehensive operating-room scheduling policies and regulations. The more immediate causes were: (1) the use of two separate and independently-functioning, operating-room complexes, (2) the availability for scheduling of a number of rooms and hours greatly exceeding the demand, (3) operating-room delays, particularly those caused by late surgeons and anesthesiologists, (4) elective surgery performed outside of the regular hours, and (5) deficiencies in the scheduling procedures.

Recommended to improve the schedules are: (1) comprehensive and enforced scheduling policies and regulations, (2) limitation of all surgery to one of the operating-room complexes exclusively, thus simplifying staffing and

increasing the percentage of utilized time, (3) reduction of the hours in the routine surgical schedule, (4) modification of the scheduling procedures, and (5) increased support from central supply.