

A STUDY TO DETERMINE IMPROVEMENTS IN COMMUNICATION AND  
COORDINATION BETWEEN THE DEPARTMENTS OF RADIOLOGY  
AND CLINICAL LABORATORY OF MOBILE INFIRMARY,  
MOBILE, ALABAMA

A Project Report Submitted to the Faculty of

Baylor University

In Partial Fulfillment of the

Requirements for the Degree

of

Master of Hospital Administration

By

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A STUDY TO DETERMINE THE EFFECTS OF ORGANIZATION AND  
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MOBILE, ALABAMA

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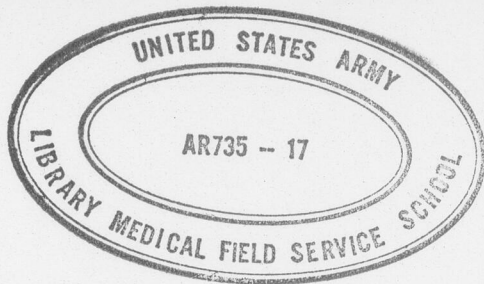


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CHAPTER I

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The modern hospital can be all things to all men. It is the workshop of the professional, the haven of the patient, the pride of the community. This same modern hospital is under attack to reduce both its operating costs and improve the delivery of health care. If the hospital is to meet this challenge, a mandatory requirement would be for a fresh look at traditional methods of interdepartmental communication and coordination. If one describes the hospital as a system in which the input is the ailing and the output is the cured, then one can visualize simultaneous demands on the system being generated by the input. To foresee these simultaneous demands arising within the clinical laboratory, the radiology department, and the rehabilitation department is not unreasonable. In 1964, James J. Souder stated that few hospitals have efficient coordination of the demands of various hospital disciplines. However, the hospital does present certain distinguishable patterns, one of them being vertically organized departments based upon a particular service. Examples of vertically organized departments are clinical laboratory, radiology, pharmacy, and personnel. Additionally, these departments are interrelated with many

activities of one department reflected in the activities of the others. In 1966, an editorial in Hospitals observed:

## CHAPTER I

### INTRODUCTION

The modern hospital can be all things to all men: the workshop of the professional, the haven of the patient, the pride of the community. This same modern hospital is under attack to reduce both its operating costs and improve the delivery of health care. If the hospital is to meet this challenge, a mandatory requirement would be for a fresh look at traditional methods of interdepartmental communication and coordination. If one describes the hospital as a system in which the input is the ailing and the output is the cured, then one can visualize simultaneous demands on the system being generated by the input. To foresee these simultaneous demands arising within the clinical laboratory, the radiology department, and the rehabilitation department is not unreasonable. In 1964, James J. Souder stated that few hospitals have efficient coordination of the demands of various hospital disciplines. However, the hospital does present certain distinguishable patterns, one of them being vertically organized departments based upon a particular service. Examples of vertically organized departments are clinical laboratory, radiology, pharmacy, and personnel. Additionally, these departments are interrelated with many

activities of one department reflected in the activities of the others.<sup>1</sup> In 1966, an editorial in Hospitals observed:

Current methods of hospital operation, especially the communication between departments, are pitifully inefficient. From the moment of admission, the patient's management depends upon an array of manual routines, most of which involve the creation of handwritten [or typewritten records], rewriting of slips and cards, and telephone messages.<sup>2</sup>

### Purpose and Scope of the Study

Rising hospital costs have necessitated newer and more efficient methods for delivering medical care. Discussing rising costs, Dr. McGibony stated: "Hospitals are reacting to these [increased costs] forces by directing their attention and efforts toward the improvement of patient care, better utilization of personnel, more efficient management."<sup>3</sup> The administrator of Mobile Infirmary, Mobile, Alabama, desired that a study be made to achieve one or more of these objectives. The writer made the arbitrary decision to limit this study to improving communication and coordination between radiology and clinical laboratory.

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<sup>1</sup>James J. Souder, et al., Planning for Hospitals (Chicago: American Hospital Association, 1964), pp. 1-5.

<sup>2</sup>"Editorial Notes," Hospitals, XL (September 16, 1966), 71.

<sup>3</sup>John R. McGibony, "Hospital Administrative Research," Hospital Management, XCVIII (August, 1964), 50.

### Statement of the Problem

To determine the improvements, within the resources of Mobile Infirmery, Mobile, Alabama, that may be effected to better communication and coordination between the departments of radiology and clinical laboratory.

### Criteria

The following criteria are established for the conduct of this study:

1. There should be a reduction in the degree of handling by departmental personnel of both X-ray and clinical laboratory examination requests.
2. The improvements should be flexible enough to adapt to future demands of workload and/or new techniques.
3. Any improvements in interdepartmental communication and coordination should be compatible with present hospital procedures.

### Factors Bearing on the Problem

1. Mobile Infirmery has an on-site computer with sufficient core storage for almost any program that may be written.
2. The data-processing department operates on a 24-hour schedule.
3. Mobile Infirmery has ordered an International Business Machine 1080 Data Collection System for delivery within one year.

4. Mobile Infirmary has ordered International Business Machine 2260 Visual Display Terminal for delivery after one year.

#### Definition of Terms

The following definitions are applicable only to this study:

1. Clinical Laboratory Department--The division within the hospital that analyzes and reports results of patient specimens.
2. Diagnostic X-ray--The film which aids the physician in diagnosing disease or injury.
3. Laboratory Request--The printed form that is prepared by the nurse on a nursing unit to order any clinical laboratory test.
4. Multiple Scheduling--The ordering of patient test or examinations to be performed by two or more departments on the same day.
5. Nursing Unit--An area within the hospital which contains patient rooms and a nurses' station.
6. Radiology Department--The division within the hospital which makes and interprets diagnostic X-rays.
7. Specimen Collector--An individual from clinical laboratory who proceeds to the nursing unit to obtain the required patient specimens.

8. X-ray Request---The printed form that is prepared by the nurse on a nursing unit to order any radiological procedure.

#### Review of the Literature

Periodicals, books, and other sources covering the period from 1961 to the present were surveyed to obtain pertinent information concerning methods employed for improving interdepartmental communication and coordination.

Inherent in any administrative function are situations which causes one to reflect on the established methods, procedures or systems.

An analysis of physicians' orders has shown that nearly 70 per cent of all orders fall into one of four categories: medications, diets, clinical laboratory tests, or radiological examinations.<sup>4</sup> Therefore, any method which coordinates these four categories would improve interdepartmental communication and coordination. One effective method is that of central scheduling, the crux of which is compiling and distributing master schedules that specify all departmental tests or examinations to be accomplished the following day on a given patient. The key to success lies in the advanced distribution of the schedule, both to nursing units and to involved departments. This permits each department to acquire a perspective of its contribution to the overall

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<sup>4</sup>"A Central Electronic Computer Speeds Patient Information," Hospital Management, XCVI (September, 1963), 82.

treatment program. Even though operating a central scheduling system provides an information center for departmental demands on a patient, the major problem to guard against is letting priorities disrupt the basic system.<sup>5</sup>

Achieving effective interdepartmental communication and coordination results in: (1) better use of information from records and requests, (2) more effective management of both the patient and the hospital resources, and (3) more efficient use of personnel. While discussing the benefits of automation when applied to a hospital, Souder stated:

Specifically, the system should provide timely and complete statements and financial data; additional and improved information to the medical staff and various specialty departments; . . . improved utilization of the clerical and medical staffs; and an ability to utilize new developments in automation as they become available and are considered feasible.<sup>6</sup>

Generally speaking, hospital applications of the computer have been limited to providing financial data because: (1) the success of industry in using the computer to produce financial data, (2) the obvious monetary benefits derived from computer applications, and (3) the conservatism of hospitals.<sup>7</sup> The problem in applying the computer to the

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<sup>5</sup>Eugene E. Tillock, William W. Abendroth, and Graham D. Clapp, "Central Scheduling Smooths the Work Flow," Modern Hospital, CIX (September, 1967), 123+.

<sup>6</sup>Souder, et al., p. 15.

<sup>7</sup>Paul B. Hofmann, William A. Gouvera, and G. Otto Barnett, "Computers: Great Future, Perilous Present," Modern Hospital, CXI (July, 1968), 98-100; 148.

medical staff and various specialty departments to produce better patient care has been in the failure of the administrator to ask the right questions. As John Diebold succinctly states,

It is the failure in particular to seek quantitative measurement of the very real benefits of automatic data processing (ADP) to a business. I do not mean cost displacement but rather increased management capacity to control and plan. Such benefits are not being considered in a serious and meaningful way; yet they are today the principal reason for computer use and for moving computers out of accounting and into operational use.<sup>8</sup>

Although the computer has aided in improving the delivery of health care, it should not be considered the panacea for all problems of the modern hospital. Too often, there comes a day of reckoning and disillusionment. The benefits anticipated from a computer do not manifest themselves for the computer cannot remove existing inefficiencies. Unless these deficiencies are corrected, they are simply assimilated into an automated system. While there have been computer applications in the areas of clinical laboratories and administration, there is no current computer program which totally interrelates all the departments.<sup>9</sup> Today's modern hospital presents a complex environment in which to introduce automation and the

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<sup>8</sup>John Diebold, "Bad Decisions on Computer Use," Harvard Business Review, XLVII (January-February, 1969), 14-27; 146.

<sup>9</sup>"Editorial Notes," p. 71.

medical staff. Realistically, however, with tomorrow's potential for expansion the hospital cannot afford to neglect the benefits of automation. Indeed, each hospital must analyze its own needs and must develop specific programs to meet these needs.

### Method of Presentation

This paper is divided into three chapters.

Chapter I, "Introduction," dealt with the introduction of the problem, criteria which must be met, factors bearing on the problem, definition of terms, methodology used, review of the literature, and the method of presentation.

Chapter II, "Discussion," is composed of a discussion and flow chart of the current network of communication and coordination between the department of radiology and the clinical laboratory, an analysis of statistical data, a statement of suggested improvements for parallelism, and a summary.

Chapter III, "Conclusions and Recommendations," consists of the conclusions and the recommendations of the investigator.

The informed nurse plays a key role here, for as she reviews her patient's chart, she may learn that he had barium a day or two before the newly-devised procedure. The starting, stopping, and scheduling of intravenous

Roscoe E. Miller and Shirley Gerard, "The Nurse on the Radiological Team," American Journal of Nursing, LXIV (July, 1964), 138.

## CHAPTER II

### DISCUSSION

#### Current Interdepartmental Communication Network

This chapter explores the components of the current interdepartmental communication and coordination network. The components comprising this network are: the nursing unit, the department of radiology, and the department of clinical laboratory. Their individual contribution to the communication and coordination network is discussed in the following paragraphs.

#### Nursing units

The writer noted that the orders written by physicians did not always specify the priorities to be followed when scheduling patient examinations. Apparently, the underlying rationale is that the nurse can provide the required interdepartmental liaison. This thinking is not uncommon, as most hospitals still rely upon the nurse to perform the required coordination for various orders.<sup>1</sup>

The informed nurse plays a key role here, for as she reviews her patient's chart, she may learn that he had barium a day or two before the newly-desired procedure. The starting, stopping, and scheduling of intravenous

<sup>1</sup>Roscoe E. Miller and Shirley Gerard, "The Nurse on the Radiological Team," American Journal of Nursing, LXIV (July, 1964), 128.

fluids, medications, food, suction, laboratory procedures, and such examinations as bronchoscopy, cystoscopy, and proctoscopy should be coordinated so that all tests are conducted expeditiously.<sup>2</sup>

Since orders may be written any time of the day, both the 7 A.M. to 3 P.M. and the 3 P.M. to 11 P.M. nursing shifts are required to prepare and forward both laboratory and X-ray requests that must be scheduled for the next day. Regardless of the nursing shift preparing the requests, the routine followed is essentially the same. The physicians' orders are entered into the nurses' record and the necessary requests are prepared and forwarded. Although the nurse can order any radiological examination by using a single form, she must prepare a multiplicity of clinical laboratory forms--hematology, urinalysis, serology, bacteriology, miscellaneous, and the like. The majority of these requests are completed prior to the end of the 3 P.M. to 11 P.M. shift to insure their receipt in the proper department for scheduling the following day's workload prior to closing the pneumatic delivery system each night. In addition to filling out the various requests, the nurse must prepare two lists used by the morning (7 A.M. to 3 P.M.) nursing shift. One list is for patients scheduled for radiological examinations; the other is for patients scheduled for clinical laboratory. Both lists contain the patient's name and room number and the test or tests ordered. The purpose of these lists is

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<sup>2</sup>Ibid., p. 129.

to aid the nurse in coordinating departmental demands. The manner in which these lists fit into the overall communication and coordination network will be explained in the following discussion.

### Clinical laboratory

The current system of interdepartmental communication and coordination is based upon the fact that priority for patient scheduling has been granted clinical laboratory. Sometime between 5 P.M. and 9 P.M. each evening, all clinical laboratory requests are sequentially arranged by room number within nursing units. At 9 P.M. each evening, all X-ray requests are transferred to the clinical laboratory. Patients with multiple scheduling are identified at this time by comparing both department's requests. The X-ray forms of these patients are then annotated with one of three times that clinical laboratory anticipates completion of their requirements. These times are: 8 A.M. for tests that require a fasting sample; 9 A.M. for tests that correspond to a medium-time procedure (for example, a bromsulphalein test); and 12 noon for those tests that correspond to a long-time procedure (for example, glucose tolerance tests). However, the clinical laboratory tests are not marked to identify the patients with multiple scheduling. Not only must the personnel match and annotate the X-ray requests, but they must also enter the proper procedural-billing code in each clinical laboratory request

prior to delivering the requests to data processing for patient billing. The administrative supervisor of laboratories recognized the need for improving communication and coordination and for reducing handling time.<sup>3</sup>

Each morning at 7 A.M., specimen collectors, carrying the individual slips for patient and test identification, are dispatched to the nursing units. Once the samples are obtained, these technicians are responsible for indicating completion of sample collections by deleting the patients' names from the list maintained by the nurse. Only upon deletion is the nurse assured that patients are free for other departments. The importance gained by these lists is illustrated best by Figure 1.

### Radiology

When the X-ray requests are returned from the clinical laboratory, they are separated into one of four examination categories: flouroscopy, intravenous pylogram, routine, and chest. Those requests with release times indicated are filed chronologically within the proper examination category. Whenever a release time arrives, the staff members attempt to fit the patient into their operation by using one of two methods to determine patient status. The first is to telephone the nurse in the nursing unit who

<sup>3</sup>Personal interview with J. M. Walters, Administrative Supervisor of Clinical Laboratories, Mobile Infirmmary, Mobile, Alabama, May 8, 1968.

FIGURE 1. FLOW CHART OF THE PRESENT NETWORK

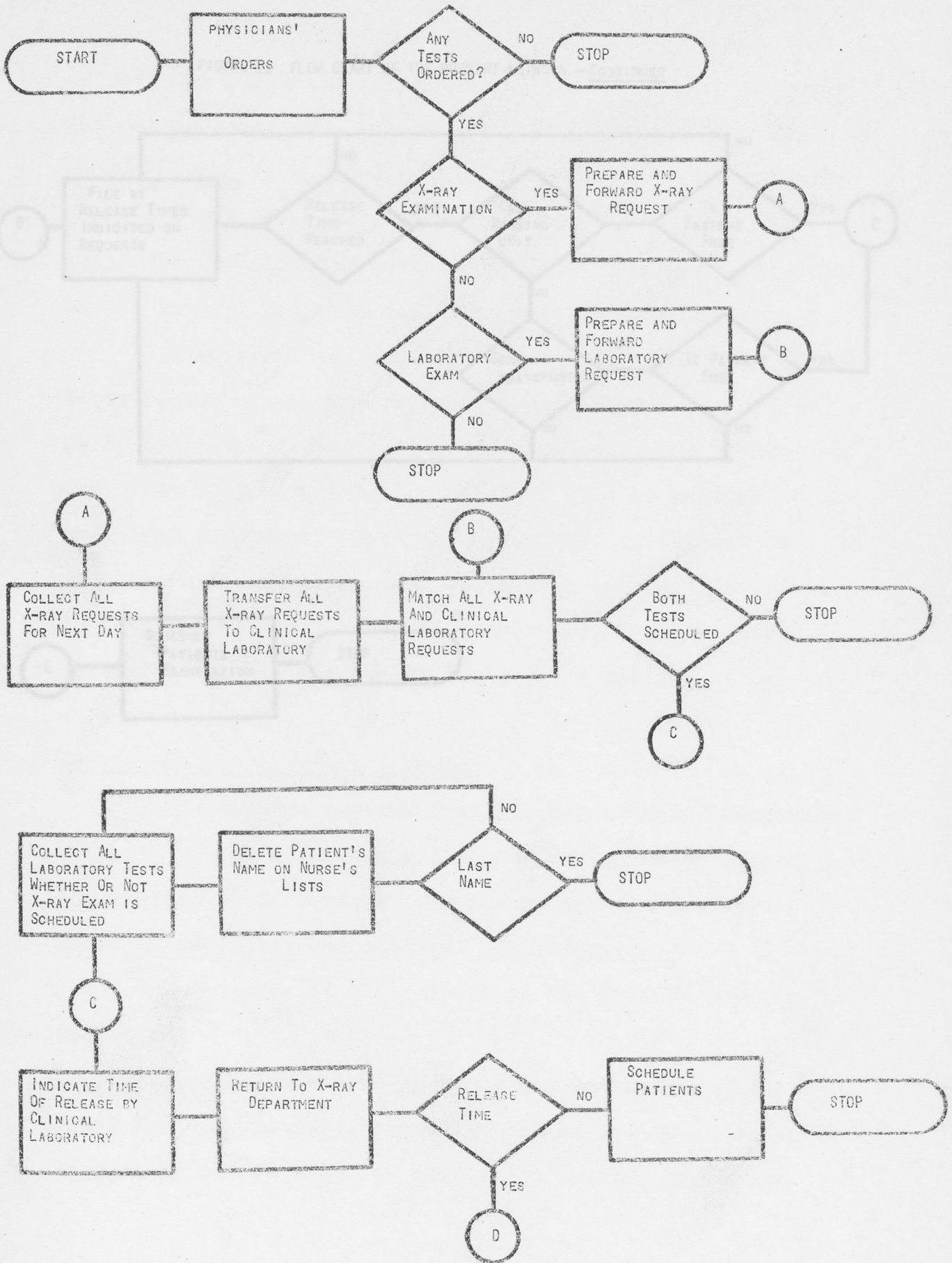
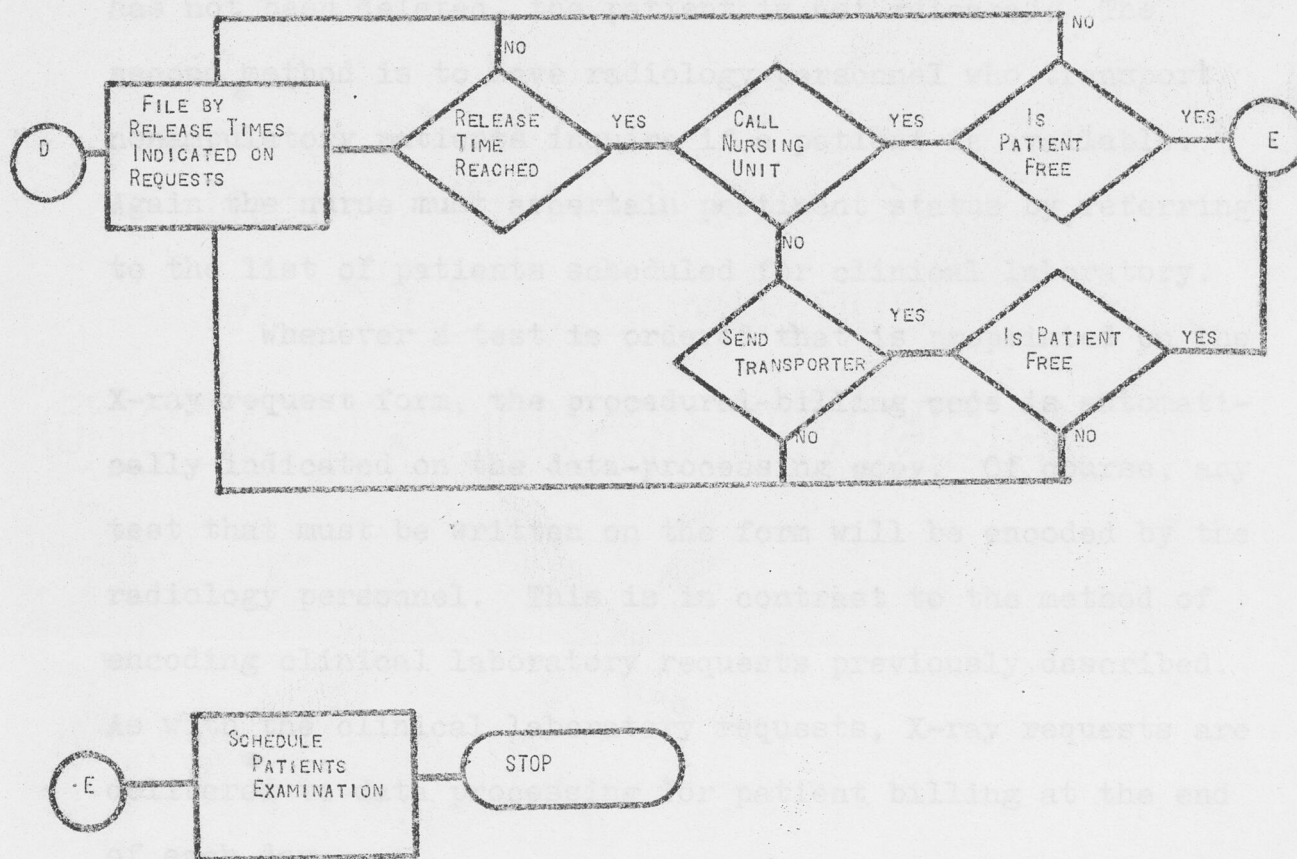


FIGURE 1. FLOW CHART OF THE PRESENT NETWORK --CONTINUED



#### Weaknesses of the present system

The present network for interdepartmental communication and coordination has weaknesses in two major areas: nursing units and network interaction between the departments of radiology and clinical laboratory.

Weaknesses of the network in the area of nursing units are:

1. The nurse who uses the information on the prepared lists of patients scheduled for radiology or clinical laboratory is not familiar with these lists. Therefore,

determines if the patient is free by referring to the list of patients scheduled for clinical laboratory. If his name has not been deleted, the patient is not released. The second method is to have radiology personnel who transport nonambulatory patients inquire if a patient is available. Again the nurse must ascertain pertinent status by referring to the list of patients scheduled for clinical laboratory.

Whenever a test is ordered that is preprinted on the X-ray request form, the procedural-billing code is automatically indicated on the data-processing copy. Of course, any test that must be written on the form will be encoded by the radiology personnel. This is in contrast to the method of encoding clinical laboratory requests previously described. As with the clinical laboratory requests, X-ray requests are delivered to data processing for patient billing at the end of each day.

#### Weaknesses of the present system

The present network for interdepartmental communication and coordination has weaknesses in two major areas: nursing units and network interaction between the departments of radiology and clinical laboratory.

Weaknesses of the network in the area of nursing units are:

1. The nurse who uses the information on the prepared lists of patients scheduled for radiology or clinical laboratory is not familiar with these lists. Therefore,

she must search the list each time there is a requirement to determine if a patient is free.

2. These lists have assumed an exaggerated importance, for there are instances a patient's name is not deleted even though clinical laboratory collections are complete.

3. The radiology department is dependent upon the nurse for information that could be obtained elsewhere.

4. There is little consideration given by the nurse as to test compatibility when ordering various tests. This point was emphasized in Chapter I, "Review of the Literature."

Weakness of the network in interdepartmental communication and coordination is seen in the apparent disregard of any radiological requirements by the clinical laboratory. In addition to not identifying patients common to both departments, as discussed in the section "Radiology," other components that are in need of improvement are:

1. The compatibility of various tests to be performed by both departments should be determined. There are clinical laboratory tests which require the patient to swallow liquids; for example, glucose tolerance tests. Such tests will negate any radiology test that requires an empty gastro-intestinal tract.

2. The specimen collectors fail to give priority to patients with multiple scheduling for the reason previously

discussed--the lack of patient identification. This can result in a patient scheduled for a complex radiological examination; for example, an upper and lower gastrointestinal flouroscopy, waiting for approximately one hour to have a small sample of blood drawn. This clinical laboratory procedure, requiring less than five minutes, ties the patient up until seen by the specimen collector and released.

3. The department of radiology is dependent upon the nursing unit for patient information that could best be obtained from the clinical laboratory.

#### Statistical Data

The intervals covered by all data were selected for the convenience of the investigator and were considered representative.

#### Frequency of simultaneous X-ray and laboratory procedures

Data were collected for the period February 2, 1968, through March 10, 1968. As shown in Table 1, 390 nursing unit-days were possible; data were determined for 249 nursing unit-days.

A list in descending frequency of the nursing unit-days and the percentage that frequency represents can be seen in Table 2.

The investigator will disregard both the 100 per cent and the 0 per cent categories for the following reason: both

TABLE 1

PATIENTS WITH MULTIPLE SCHEDULING BY NURSING UNIT

DATE	2E	2W	3NW	3W	3E	4N	4NW	4W	4E	5N	5NW	5W	5E
2-12	8/11 72%	4/7 57%		2/4 50%	3/3 100%		4/11 36%	2/7 29%			7/9 78%		2/4 50%
2-13	1/7 14%	1/3 33%	1/3 33%	0/1 0%		1/1 100%	1/4 25%	2/4 50%	1/1 100%	3/6 50%	2/4 50%	1/3 33%	
2-14	1/3 33%		1/4 25%	1/2 50%		3/3 100%	3/9 33%		0/5 0%		0/2 0%	1/4 25%	2/5 40%
2-15	3/7 43%	2/6 33%	1/1 100%	1/3 33%		1/1 100%	2/4 50%	1/2 50%	1/2 50%		5/7 71%		4/6 66%
2-16	3/7 43%	1/6 17%	2/2 100%					1/1 100%		3/3 100%	3/5 60%	4/8 50%	3/6 50%
2-17	2/8 25%	1/2 50%	1/1 100%	1/1 100%	2/2 100%	0/3 0%	1/5 20%	2/5 40%	1/2 50%	3/5 60%	1/3 33%	3/5 60%	3/5 60%
2-18		0/1 0%						2/5 40%	0/1 0%		0/1 0%		
2-19	3/4 75%	2/6 33%			2/3 66%	1/4 25%	2/3 66%	4/8 50%	3/3 100%	4/6 66%	4/10 40%	5/9 56%	3/4 75%
2-20	0/5 0%		2/7 29%				3/5 60%	0/4 0%			2/7 29%	3/5 60%	
2-21	3/5 60%			0/1 0%	0/1 0%		1/3 33%		0/1 0%	3/3 100%	1/2 50%	1/7 14%	
2-22	2/3 66%	2/3 66%		0/5 0%		1/5 20%	2/5 40%		3/5 60%		5/7 71%		
2-23	3/3 100%		4/6 66%	3/3 100%		0/2 0%	0/2 0%	1/2 50%	3/5 60%		3/7 43%	4/5 80%	3/5 60%
2-24	1/2 50%	1/2 50%		0/2 0%			5/7 71%	2/4 50%	1/2 50%	1/1 100%	4/6 66%	0/2 0%	1/5 20%
2-25				1/3 33%	2/5 40%	0/3 0%		3/6 50%					
2-26		1/5 20%		3/9 33%	3/9 33%	2/2 100%		1/6 17%		2/5 40%	3/7 43%	0/2 0%	3/7 43%
2-27	1/3 33%	1/1 100%	1/1 100%	1/3 33%	1/2 50%	0/1 0%					1/1 100%		
2-28	3/11 27%	2/5 40%	1/6 17%	1/5 20%	3/7 43%		3/4 75%	1/5 20%		4/9 44%	1/9 11%	3/4 75%	3/4 75%
3-1		0/1 0%	3/3 100%		2/2 100%	1/3 33%	2/6 33%	0/1 0%	2/7 29%	1/1 100%	1/5 20%		3/5 60%
3-2	3/9 33%	2/4 50%	0/2 0%	3/7 43%	2/5 40%	1/3 33%	1/4 25%	1/4 25%			1/2 50%	3/7 43%	
3-3		1/1 100%		0/1 0%	1/1 100%		2/5 40%	4/5 80%	3/7 43%	0/2 0%		2/5 40%	
3-4	3/5 60%	2/2 100%	1/2 50%	1/1 100%	1/6 17%		2/6 33%	1/1 100%	0/1 0%	1/4 25%	3/5 60%	2/5 40%	4/6 66%
3-5	1/2 50%	2/4 50%				2/6 33%	3/6 50%	4/8 50%			5/6 83%	2/7 29%	1/2 50%
3-6			1/3 33%		0/2 0%		1/1 100%	2/2 100%					
3-7	4/5 80%	2/2 100%	3/3 100%		1/1 100%	1/5 20%	4/9 44%				1/6 17%		3/4 75%
3-8	0/3 0%	6/8 75%			2/3 66%	3/3 100%	3/7 43%		1/3 33%	5/9 55%	1/3 33%		1/1 100%
3-9	2/2 100%	2/5 40%		0/2 0%	1/4 25%	4/6 66%	3/4 75%	2/7 29%	1/4 25%	0/3 0%	6/8 66%	1/3 33%	
3-10	2/4 50%	2/4 50%	0/2 0%	4/6 66%	2/4 50%	2/2 100%	0/3 0%	3/7 43%			3/6 50%		
3-11		1/2 50%		1/3 33%			0/4 0%		1/1 100%	3/3 100%	1/5 20%	4/8 50%	4/4 100%
3-12	4/6 66%	0/3 0%				0/2 0%	1/3 33%	1/2 50%		3/4 75%	1/4 25%	1/5 20%	
3-13								1/1 100%					

of X-ray-clinical laboratory examinations ordered, as reported by the Commission on Professional and Hospital

TABLE 2

FREQUENCY OF SIMULTANEOUS X-RAY AND LABORATORY PROCEDURES

Nursing-unit days	Percentage of patients with laboratory orders
41	100
38	50
35	0
28	33
14	60
13	66
13	40
11	43
11	25
10	75
10	20
6	29
4	17
3	71
2	80
2	44
2	14
1	78
1	72
1	57
1	56
1	55
1	27
1	11

can be dependent upon only one patient, either being or not being simultaneous scheduled for radiology and clinical laboratory. The writer noted that the second highest frequency of patients scheduled for both X-ray and clinical laboratory tests closely paralleled the national averages of X-ray-clinical laboratory examinations ordered, as reported by the Commission on Professional and Hospital

TABLE 3

CUMULATIVE PERCENTAGE OF INDIVIDUAL X-RAY  
PROCEDURES AS COMPARED TO  
THE CUMULATIVE TOTAL

Procedure	Cumulative Total	Cumulative Percentage
1. CHEST	1168	26.96
2. G.I. SERIES	1564	36.11
3. BARIUM ENEMA--COLON	1933	44.63
4. INTRAVENOUS PYLOGRAM	2293	52.94
5. GALLBLADDER	2635	60.84
6. SKULL	2838	65.52
7. PORTABLES IN ADDITION TO REGULAR CHARGE	3012	69.54
8. SPINE--LUMBAR WITH OBLIQUES	3147	72.66
9. SPINE--CERVICAL WITH OBLIQUES	3147	72.66
10. KUB	3270	75.50
11. SINUSES	3375	77.92
12. SPINE--DORSAL AP AND LATERAL	3442	79.47
13. HIP--AP AND LATERAL	3502	80.85
14. SHOULDER	3560	82.19
15. ABDOMEN--FLAT ERECT LATERAL DECUBITUS	3609	83.32
16. G.I. SERIES AND SMALL BOWEL	3653	84.34
17. PELVIS--AP ONLY	3697	85.36
18. PELVIS--LATERAL HIP	3738	86.30
19. KNEE	3771	87.06
20. ANGIOGRAMS--USING SANCHEZ- PEREZ	3803	87.80
21. POST REDUCTION FILMS IN OPERATING ROOM	3834	88.52
22. LAMINOGRAPHS	3865	89.24
23. MYELOGRAM	3895	89.93
24. GALLBLADDER--RECHECK	3923	90.57
25. TIBIA AND FIBULA	3950	91.20
26. ELBOW	3976	91.80
27. HAND--SINGLE	3996	92.26
28. RIES	4331	92.70
29. ANKLE	4034	93.14
30. CYSTOGRAM	4050	93.51
31. FOOT	4066	93.88
32. CHOLANGIOGRAM--INTRAVENOUS	4082	94.25
33. FEMUR	4096	94.57
34. WRIST--EITHER	4110	94.89

TABLE 3--Continued

Procedure	Cumulative Total	Cumulative Percentage
35. PELVIMETRY PLACENTOGRAPHY	4123	95.19
36. VOIDING CYSTOURETHROGRAM	4135	95.47
37. MAMMOGRAM	4147	95.75
38. AORTOGRAM	4158	96.00
39. HIP NAILING IN OPERA- TING ROOM	4167	96.21
40. CHOLANGIOGRAM IN OPERA- TING ROOM	4176	96.42
41. MANDIBLE	4184	96.60
42. SMALL BOWEL SERIES WITH- OUT G.I. SERIES	4192	96.79
43. SPINE-LATERAL CERVICAL IN OPERATING ROOM	4200	96.79
44. ARM-FOREARM	4208	97.16
45. CHEST FLUOROSCOPY-WITH CHEST FILMS	4215	97.32
46. CHEST WITH OBLIQUES	4222	97.48
47. FACIAL BONES	4229	97.64
48. MASTOIDS	4236	97.80
49. BRONCHOGRAM-WITH OR WITHOUT CHEST FILM	4243	97.96
50. CHEST FLUOROSCOPY	4249	98.10
51. COCCYX AND SACRUM	4255	98.24
52. PACEMAKER	4260	98.36
53. CHEST IN OPERATING ROOM	4265	98.47
54. ABDOMEN-AP AND LATERAL	4269	98.56
55. BONE SURVEY INCLUDING AP AND LATERAL SKULL	4272	98.63
56. CHOLANGIOGRAM-T-TUBE	4275	98.70
57. CLAVICLE	4278	98.77
58. ENCEPHALOGRAM	4281	98.84
59. HIP-AP ONLY	4284	98.91
60. LONG BONES-ADULTS	4287	98.98
61. SPINE-CERVICAL	4290	99.05
62. STEROTACTIC PROCEDURE	4293	99.12
63. VENTRIC MARKING	4296	99.19
64. ABDOMEN-FLAT	4299	99.26
65. ARM-HUMERUS	4301	99.30
66. ARTERIOGRAM	4305	99.39
67. ARTERIOGRAM FEMORAL IN OPERATING ROOM	4307	99.44
68. CHEST IN INSPIRATION AND EXPIRATION	4309	99.49

TABLE 3--Continued

Procedure	Cumulative Total	Cumulative Percentage
69. FLUOROSCOPIC WITHOUT FILMS	4311	99.53
70. HANDS-BOTH	4313	99.58
71. LEG	4315	99.63
72. LONG BONES--CHILD	4317	99.67
73. NOSE	4319	99.72
74. ORBITS--OPTIC FORAMEN.	4321	99.76
75. SPINE-LUMBAR	4323	99.81
76. AORTOGRAM WITH SANCHEZ-- PEREZ SERIALOGRAPH	4324	99.83
77. CHEST FOR RIBS AND ROUTINE CHEST FILM	4325	99.86
78. FEET-BOTH	4326	99.88
79. SACROILLIAC JOINTS	4327	99.90
80. SCAPULA	4328	99.93
81. TEMPOROMANDIBULAR JOINT	4329	99.95
82. TOES	4330	99.97
83. UTEROTUBOGRAM	4331	100.00

Activities<sup>4</sup> (see Appendix).

Frequency of x-ray examinations

The frequency of individual radiological examinations ordered for the month of April, 1968, was examined to determine the percentage of individual examinations which comprise at least 80 per cent of the total radiological examinations performed. The frequency of a given procedure is compared to the cumulative percentage of total procedures in Table 3.

<sup>4</sup>"Frequency of Laboratory Test and X-rays," The Record: Commission on Professional and Hospital Activities, II (July 1, 1964), 1-4.

There were 42 additional examinations which were not ordered during the period covered. As shown by Table 3, the first 13 examinations constitute 80.85 per cent of the total procedures requested but only 10.32 per cent of all possible tests.

#### Frequency of fluoroscopy and intravenous pyelogram examinations

The period covered was April 1, 1968, through April 30, 1968 (see Table 4).

The outpatient examinations constitute 3.2 per cent of the total fluoroscopy procedures accomplished during the period covered. The outpatient workload in fluoroscopy was not considered to be significant and was disregarded within the study.

The mean for fluoroscopies on the inpatient is 48.4 examinations per day; the median is 46.5; the mode is 47; and the range is 28-65. The outpatient examinations constitute 6.9 per cent of the total intravenous pyelogram examinations studied and were not considered significant to the study. The mean for intravenous pyelograms on the inpatients is 23.5 examinations per day; the median is 19.5; the mode is 23; and the range is 3-37.

#### Frequency of laboratory requests

The writer determined the frequency of individual tests performed by each clinical laboratory service for the month of April, 1968, to determine the percentage of individual tests by service comprising at least 80 per cent of

TABLE 4

FREQUENCY OF FLUOROSCOPY AND INTRAVENOUS  
PYLOGRAM EXAMINATIONS

Day*	Fluoroscopy Inpatient	Outpatient	Intravenous Inpatient	Pylogram Outpatient
1	47	4	23	0
2	47	1	31	1
3	52	3	18	1
4	33	1	20	0
5	45	4	16	1
6	42	0	15	3
7	0	0	3	1
8	59	0	30	3
9	65	2	25	2
10	47	1	20	1
11	46	2	22	2
12	48	2	32	0
13	54	1	15	0
14	0	0	0	2
15	43	0	33	1
16	57	0	23	7
17	59	1	15	1
18	48	1	29	1
19	52	1	24	2
20	28	0	18	1
21	0	0	0	1
22	49	0	37	2
23	51	0	34	2
24	49	5	23	1
25	42	2	17	2
26	34	4	19	4
27	44	1	22	1
28	0	0	0	2
29	64	2	28	0
30	55	4	24	1
Totals	1260	42	616	46

\*The 7th, 14th, 21st, and 28th are Sundays.

the total tests performed by the service.

The parasitology service is compared in Table 5.

TABLE 5  
PERCENTAGE OF INDIVIDUAL EXAMINATIONS FOR  
PARASITOLOGY AS COMPARED TO THE  
CUMULATIVE TOTAL FOR PARASITOLOGY

Test	Cumulative Total	Cumulative Percentage
1. BLOOD-OCCULT AND GROSS	222	49.77
2. STOOL-SINGLE	331	74.21
3. STOOL, PURGED, 5	394	88.34
4. STOOL, PURGED, 3	405	90.80
5. STOOL, PURGED, 2	415	93.04
6. STOOL, PURGED, 4	423	94.84
7. STOOL, PURGED, 1	431	96.63
8. PIN WORM DETERMINATION	435	97.53
9. BILIRUBIN-BILE	438	98.20
10. FAT STUDIES	441	98.87
11. STOOL, PURGED, 1	443	99.32
12. TRYPSIN DETERMINATION	445	99.77
13. PH	446	100.00

There were nine additional examinations which were not ordered during the period covered. As shown by Table 5, the first four tests constitute 90.80 per cent of the total procedures requested but only 18 per cent of all possible tests. Parasitology constitutes 2.93 per cent of all laboratory examinations ordered during the period covered.

TABLE 6  
 PERCENTAGE OF INDIVIDUAL EXAMINATIONS FOR  
 URINALYSIS AS COMPARED TO THE CUMULATIVE  
 TOTAL FOR URINALYSIS

Test	Cumulative Total	Cumulative Percentage
1. URINALYSIS-COMplete	2206	93.59
2. STAT ADDITIONAL CHARGE	2279	96.99
3. MICROSCOPIC	2293	97.28
4. UROBILINOGEN-QUANTITATIVE	2303	97.70
5. ACETONE-URINE	2312	98.09
6. BILIRUBIN-BILE	2320	98.43
7. ANALYSIS-RENAL CALCULI	2327	98.72
8. SPECIFIC GRAVITY	2334	99.02
9. ALBUMIN-QUALITATIVE	2340	99.27
10. PROTEIN-BENCE-JONES	2346	99.53
11. PORPHYRINS-URO-COPRO	2349	99.66
12. PHENOSULFOTHALEIN TEST	2351	99.74
13. ALBUMIN-QUANTITATIVE	2352	99.78
14. BLOOD-HEMATEST	2353	99.83
15. CALCIUM-SULKOWITCH	2354	99.87
16. FISHBERG CONCENTRATION TEST	2355	99.91
17. PH REACTION	2356	99.95
18. STAINED SEDIMENT	2357	100.00

There were twelve additional examinations which were not ordered during the period covered. As shown by Table 6, the first two tests constitute 96.69 per cent of the total tests ordered but only 6.6 per cent of all possible tests. Urinalysis constitutes 15.5 per cent of all laboratory examinations ordered during the period covered.

TABLE 7

PERCENTAGE OF INDIVIDUAL EXAMINATIONS FOR  
SEROLOGY AS COMPARED TO THE CUMULATIVE  
TOTAL FOR SEROLOGY

Test	Cumulative Total	Cumulative Percentage
1. RHEUMATOID ARTHRITIS	78	23.07
2. VDRL-QUALITATIVE AND QUANTITATIVE	156	46.15
3. VDRL-SPINAL FLUID	209	61.83
4. C-REACTIVE PROTEIN	246	72.78
5. AGGLUTINATIONS FEBRILE ROUTINE	282	83.43
6. ANTI-NUCLEAR ANTIBODY	302	89.34
7. MONO SLIDE TEST	312	92.30
8. COLD AGGLUTINIS	321	94.97
9. HETEROPHILE-PRESUMPTIVE AND DIFFERENTIAL	329	97.33
10. ANTI-STREPTOLUSIN	334	98.81
11. AGGLUTINATIONS FEBRILE INDIVIDUAL	336	99.40
12. STAT ADDITIONAL CHARGE	338	100.00

There was one additional examination which was not ordered during the period covered. As shown by Table 7, the first five tests constitute 83.43 per cent of the total ordered but only 38 per cent of all possible tests. Serology constituted 2.22 per cent of all laboratory examinations ordered during the period covered.

the first five tests constitute 92.69 per cent of the total ordered, but comprise only 33 per cent of all possible tests. Bacteriology constitutes 8.1 per cent of all laboratory

TABLE 8

PERCENTAGE OF INDIVIDUAL EXAMINATIONS FOR  
BACTERIOLOGY AS COMPARED TO THE  
CUMULATIVE TOTAL FOR BACTERIOLOGY

Test	Cumulative Total	Cumulative Percentage
1. CULTURE-EXCLUDING SMEAR-ROUTINE	479	38.87
2. GRAM STAIN	860	69.80
3. SENSITIVITY TEST-DISC METHOD	997	80.92
4. ACID FAST STAIN	1070	86.85
5. CULTURE-EXCLUDING SMEAR-ACID FAST	1142	92.69
6. COLONY COUNT	1166	94.64
7. CULTURE-EXCLUDING SMEAR-FUNGUS	1188	96.42
8. SENSITIVITY-DISC METHOD	1203	97.64
9. CULTURE-INCLUDING SMEAR-ROUTINE	1209	98.13
10. BRONCHOSCOPIC STUDIES	1215	98.62
11. CYSTOSCOPIC-EACH TUBE	1218	98.86
12. STOOL CULTURE-E. COLI	1221	99.10
13. DIRECT SENSITIVITY	1223	99.26
14. INDIA INK PREPARATION	1225	99.43
15. SENSITIVITY-DISC METHOD	1227	99.59
16. UROSCREEN	1229	99.75
17. VIRUS STUDIES	1231	99.91
18. SENSITIVITY-DISC METHOD	1333	100.00

There were three additional examinations which were not ordered during the period covered. As shown by Table 8, the first five tests constitute 92.69 per cent of the total ordered, but comprise only 33 per cent of all possible tests. Bacteriology constitutes 8.1 per cent of all laboratory

examinations ordered during the period covered. There are fourteen additional examinations which were not ordered during the period covered. As shown by Table 9, p. 30, the first seven tests constitute 85.62 per cent of the total ordered and only 17.8 per cent of all possible tests. Hematology constitutes 34.37 per cent of all laboratory examinations ordered during the period covered.

There were 47 additional examinations which were not ordered during the period covered. As shown by Table 10, the first 18 tests constitute 80.41 per cent of the total tests ordered and 13.3 per cent of all possible tests. Chemistry constituted 34.57 per cent of all clinical laboratory tests ordered during the period studied.

The analysis of radiological data demonstrates that 10.32 per cent of all possible tests comprises 80.85 per cent of all examinations ordered. In addition, sufficient patients scheduled for radiological examinations only should be available for the first one or two hours each morning as the data indicate that 50 per cent of all patients scheduled for radiological examination will be in this category. Subsequent completion of clinical laboratory tests should release the remaining patients. The data indicate that a combination of clinical laboratory services, comprised of 37 individual tests, will provide 80 per cent or greater of all clinical laboratory tests ordered.

TABLE 9

PERCENTAGE OF INDIVIDUAL EXAMINATIONS FOR  
HEMATOLOGY AS COMPARED TO THE  
CUMULATIVE TOTAL FOR HEMATOLOGY

Test	Cumulative Total	Cumulative Percentage
1. COMPLETE BLOOD COUNT- ROUTINE-ADMITTING	1288	24.64
2. ROUTINE BLOOD COUNT	2501	35.00
3. PROTHROMBIN TIME	3484	66.66
4. HEMOGLOBIN	3873	74.11
5. HEMATOCRIT-MICRO	4231	80.96
6. STAT-ADDITIONAL CHARGE	4475	85.62
7. SEDIMENTATION RATE	4691	89.76
8. L E CELL PREPARATION	4814	92.11
9. COAGULATION TIME-LEE WHITE	4933	94.39
10. RETICULOCYTE COUNT	4982	95.33
11. COMPLETE BLOOD COUNT	5021	96.07
12. PLATELET COUNT	5055	96.72
13. BLEEDING TIME-DUKES	5086	97.32
14. WHITE BLOOD CELL COUNT	5116	97.89
15. PARTIAL THROMBOPLASTIN TIME	5136	98.27
16. DIFFERENTIAL	5134	98.62
17. BONE MARROW-ASSIST AND STAIN SMEAR ONLY	5165	98.83
18. PERIPHERAL SMEAR TO PATHOLOGIST	5176	99.04
19. COAGULATION TIME-SLIDE	5182	99.15
20. RED BLOOD CELL INDICES	5188	99.27
21. RED BLOOD CELL COUNT	5194	99.48
22. FIBRINOGEN-QUANTITATIVE	5199	99.48
23. NASAL SMEAR	5204	99.57
24. COAGULOGram-COMplete	5208	99.65
25. EOSINOPHIL COUNT	5212	99.73
26. BLEEDING TIME-IVEYS	5215	99.78
27. CLOT RETRACTION	5218	99.84
28. PROTHROMBIN-CONSUMPTION TIME	5220	99.88
29. SICKLE CELL	5222	99.92
30. ALKALINE PHOSPHATASE STAIN	5223	99.94
31. HEMATOCRIT-WINTROBE	5224	99.96
32. MALARIA SMEAR	5225	99.98
33. RECALCIFICATION TIME	5226	100.00
34. 4-3 TO 810	4889	93.05

TABLE 10

PERCENTAGE OF INDIVIDUAL EXAMINATIONS FOR  
CHEMISTRY AS COMPARED TO THE CUMULATIVE  
TOTAL FOR CHEMISTRY

Test	Cumulative Total	Cumulative Percentage
1. SEQUENTIAL MULTIPLE ANALYSIS	823	15.66
2. GLUCOSE--SERUM	1415	26.93
3. POTASSIUM--SERUM	1731	32.94
4. UREA NITROGEN	2042	38.86
5. SODIUM--SERUM	2324	44.23
6. SGQT	2584	49.18
7. IODINE--PROTEIN BOUND	2820	53.67
8. CHLORIDES--SERUM	3032	57.70
9. LATIC DEHYDROGANASE	3241	61.68
10. PHOSPHATASE--PROSTATIC ACID	3420	65.09
11. CARBON DIOXIDE CONTENT	5381	68.15
12. SCPT	3707	70.50
13. STAT--ADDITIONAL CHARGE	3812	72.55
14. T-3 UPTAKE	3910	74.41
15. BILIRUBIN--DIRECT AND INDIRECT	3995	76.03
16. CEPHALIN FLOCCULATION	4077	77.59
17. PROTEIN--ELECTROPHORESES SERUM	4159	79.15
18. PROTEIN--TOTAL SERUM	4225	80.41
19. PHOSPHATASE--ALKALINE	4287	91.59
20. URICA ACID--SERUM	4346	82.71
21. THYMOL TURBIDITY	4404	83.82
22. CALCIUM--SERUM	4458	87.28
23. BROMSULFALEIN	4503	85.70
24. IRON	4545	86.50
25. AMYLASE--SERUM	4586	87.28
26. COPPER--SERUM	4622	87.97
27. PHOSPHORUS--SERUM	4658	88.65
28. GLUCOSE--SPINAL FLUID	4693	89.32
29. ROUTINE CHEMISTRY	4727	89.96
30. CHOLESTEROL	4761	90.61
31. GLUCOSE TOLERANCE--3 HOUR	4795	91.26
32. IRON BINDING CAPACITY	4829	91.89
33. CREATININE SERUM	4859	92.48
34. T-3 TO BIO	4889	93.05

TABLE 10--Continued

Test	Cumulative Total	Cumulative Percentage
35. ACID PHOSPHOROUS	4915	93.54
36. A/G RATIO	4939	94.00
37. TOTAL SERUM PROTEIN	4963	94.46
38. BILIRUBIN-MICRO	4986	94.89
39. BLOOD VOLUME	5009	95.33
40. GLUCOSE TOLERANCE-4 HOUR	5029	95.71
41. GLUCOSE TOLERANCE-5 HOUR	5049	96.09
42. I-131 UPTAKE	5067	96.44
43. VANILLYL MANDELIC ACID	5084	96.76
44. QUALITATIVE SPINAL FLUID	5100	97.06
45. BLOOD GAS STUDIES	5114	97.33
46. SWEAT TEST	5128	97.60
47. CREATININE-SERUM	5141	97.84
48. SPINAL FLUID-CHLORIDE	5151	98.03
49. PH	5161	98.22
50. ICTERUS INDEX	5168	98.36
51. LIPIDS-FRACTIONAL	5174	98.47
52. CREATININE CLEARANCE	5179	98.57
53. SALICYLATE LEVEL-URINE	5184	98.66
54. TRIGLYCERIDE	5189	98.76
55. 17-KETOSTERIOD	5193	98.83
56. SERUM ACETONE	5197	98.91
57. ALDOLASE	5201	98.99
58. LIPASE	5205	99.06
59. AMMONIA	5208	99.12
60. SHILLING WITH INTRINSIC FACTOR	5211	99.18
61. T-4 FREE BIO	5214	99.23
62. XYLOSE ABSORPTION STUDY	5217	99.29
63. 17-OH CORTICOSTERIODS- 17 KGS	5220	99.35
64. URINE-CALCIUM	5222	99.36
65. CREATININE URINE	5224	99.42
66. ESTROGENS	5226	99.46
67. LIPIDS SERUM	5228	99.50
68. NON-PROTEIN NITROGEN	5230	99.54
69. T-4 BY COLUMN	5232	99.58
70. UREA CLEARANCE	5234	99.60
71. 17 KETOSTERIODS-URINE	5236	99.64
72. 17-OH CORTICOSTERIODS-UR	5238	99.68
73. ALDOSTERONE	5239	99.71
74. BARBITURATES	5240	99.73
75. BROMIDE	5241	99.75

TABLE 10--Continued

Test	Cumulative Total	Cumulative Percentage
76. CATECHOLAMINES	5242	99.77
77. URINE CREATINE	5243	99.79
78. FOLLICULE STIMULATING HORMONE	5244	99.81
79. GLUCOSE TOLERANCE-6 HOUR	5245	99.83
80. HEAVY METALS	5246	99.85
81. MAGNESIUM	5247	99.87
82. PROTEIN ELECTROPHORESIS SCAN	5248	99.89
83. PROTEIN ELECTROPHORESIS-URINE	5249	99.91
84. URINE SODIUM	5250	99.93
85. URINE SUGAR CHROMATOGRAPHY	5251	99.95
86. THYROXINE BINDING GLOBULIN	5252	99.97
87. QUALITATIVE 5-HIAA SEROTONEN	5253	99.99
88. QUANTITATIVE 5-HIAA SEROTONEN	5254	100.00

#### Improvements to the Present Network

The ever-familiar problem of getting various disciplines to work together requires similarity of goals. The Comptroller discussed the hospital's goal of initiating a hospital information system designed to meet the needs of Mobile Infirmary. The equipment to be used in this system, in addition to the presently installed computer, is the 1080 Data Collection System and Visual Display Terminals mentioned in "Factors Bearing on the Problem." The automation of the communication and coordination network

between the departments of radiology and clinical laboratory offers the advantage of relating departments with relatively simple programs. These can be integrated into more sophisticated programs whenever the needs arise. After considering the present network and its weaknesses and the need to reduce handling of request forms, the writer suggests the following improvements. These improvements can be categorized into three phases: Phase 1--immediate improvements--those that would require less than six months to accomplish; Phase 2--medium-range improvements--those that would require up to one year to accomplish; and Phase 3--long-range improvements--those that would require greater than one year to accomplish.

#### Phase 1--immediate improvements

Within the nursing unit component of the network, the nurse could follow her same routine as described in "Nursing Units," with the exception that she would no longer be required to prepare separate lists of patients scheduled for X-ray and clinical laboratory tests. The request forms of clinical laboratory services could be redesigned, using the data given in "Clinical Laboratory," to determine which tests should be indicated on each request. All tests not indicated on the forms, regardless of the service, could be ordered by using only the miscellaneous form depicted in Figure 2.

Data processing would prepare four computer-scanned lists with the following information:

NAME DOCTOR		DETERMINATION REQUESTED:	
ADDRESS IF O. P.		CLINICAL DATA:	
COLLECTED BY:	DATE	the tests ordered for that patient could be identified.	
RESULTS:			
<p>1. A list of all patients scheduled only for X-ray examinations. The patients could be arranged sequentially by floor, nursing unit, and room number; in addition to sequential patient identification within the nursing unit.</p> <p>2. A list of all patients scheduled only for clinical laboratory test. Information requirements for this list are identical to those above with the exception that clinical laboratory tests would be identified.</p> <p>3. A list of patients with multiple scheduling.</p>			
L-2-1-R	CHG.	DATE	TECH. PATH. 200105 MISCELLANEOUS

FIGURE 2--MISCELLANEOUS REQUEST FORM

Upon receipt of requests, both the department of radiology and the clinical laboratory would follow similar routines. Each department would enter any procedural-billing codes not automatically indicated and forwarded the encoded copies to data processing prior to 2 A.M. each morning. This could permit a reduction in handling by departmental personnel for two reasons. First, only one form requires encoding by departmental personnel; and, second, information from "Statistical Data" indicates that the miscellaneous form would be used less than 20 per cent of the time for ordering tests. Furthermore, the clinical laboratory Data processing would prepare four computer-composed lists with the following information:

1. A list of all patients scheduled only for X-ray examinations. The patients could be arranged sequentially by floor, nursing unit, and room number. In addition to sequential patient identification within the nursing unit, the tests ordered for that patient could be identified.

2. A list of all patients scheduled only for clinical laboratory test. Information requirements for this list are identical to those above with the exception that clinical laboratory tests would be identified.

3. A list of patients with multiple scheduling. This list not only could combine lists 1 and 2 information requirements but could also indicate patient release times, using the current time criteria. If desired, any patient scheduled with incompatible test could be indicated.

4. A list of patients within one of the four radiological examination categories. This list would require only the patient's identification, sequential arrangement by floor, nursing unit and room, and release times.

These various lists would benefit communication and coordination in that identical information would be available on patients common to both departments. An initial benefit to the clinical laboratory would also be that the specimen collectors can use these lists, rather than individual requests, to make rounds and give priority to patients with multiple scheduling. Furthermore, the clinical laboratory could assume the responsibility for informing the

department of radiology whenever release times will not be met. A flow chart showing how these improvements would change the network can be seen in Figure 3.

#### Phase 2--medium-range improvements

Initiation of this phase of improvements could be upon installation of the 1080 Data Collection System referred to in "Factors Bearing on the Problem." This system permits connection of clinical laboratory equipment directly to the computer to produce listings of individual test results. At this time, consideration could be given to re-examining inter- and intradepartmental priorities and adding other patient-related departments to the lists suggested in Phase 1 improvements. These suggestions would allow centralized scheduling as discussed in "Review of the Literature."

#### Phase 3--long-range improvements

The final phase of improvements suggested for improving interdepartmental communication and coordination would be upon the installation of the 2260 Visual Display Terminals in the nursing units. As these terminals by-pass all service departments, such as radiology and clinical laboratory, the nurse can be provided direct access to the computer. Combining centralized scheduling with this direct access will provide the basis for a hospital information system meeting the needs of Mobile Infirmary.

FIGURE 3 FLOW CHART SHOWING IMPROVEMENTS  
 FIGURE 4 FLOW CHART SHOWING IMPROVEMENTS

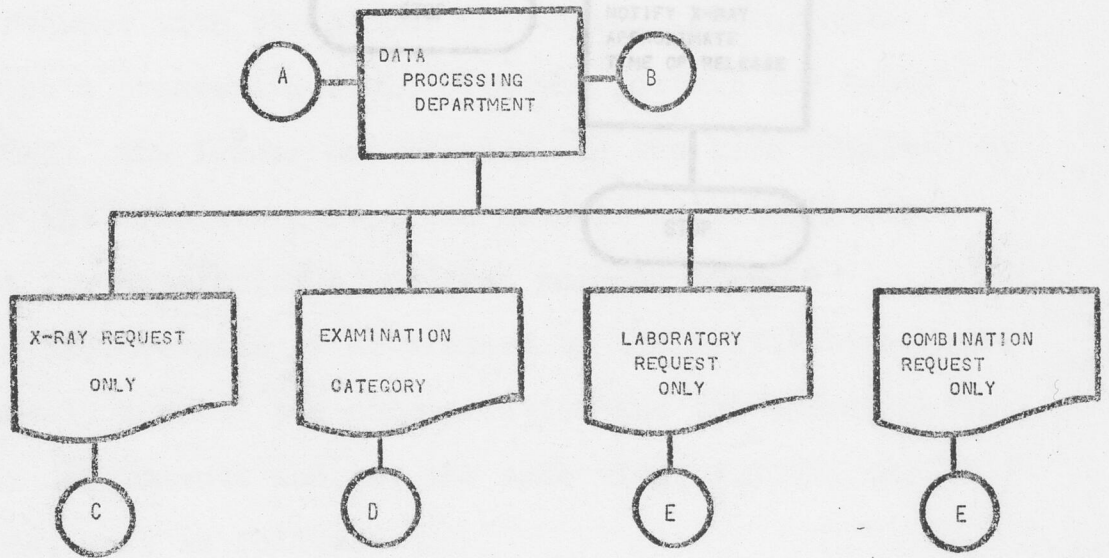
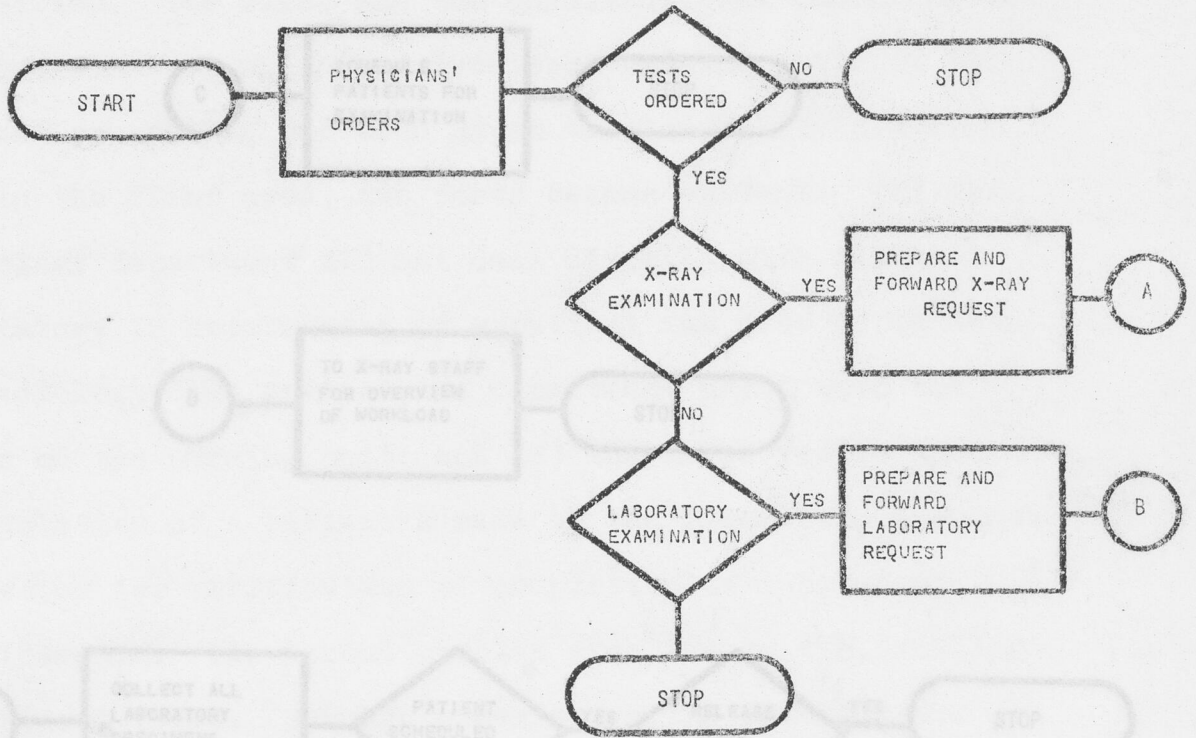
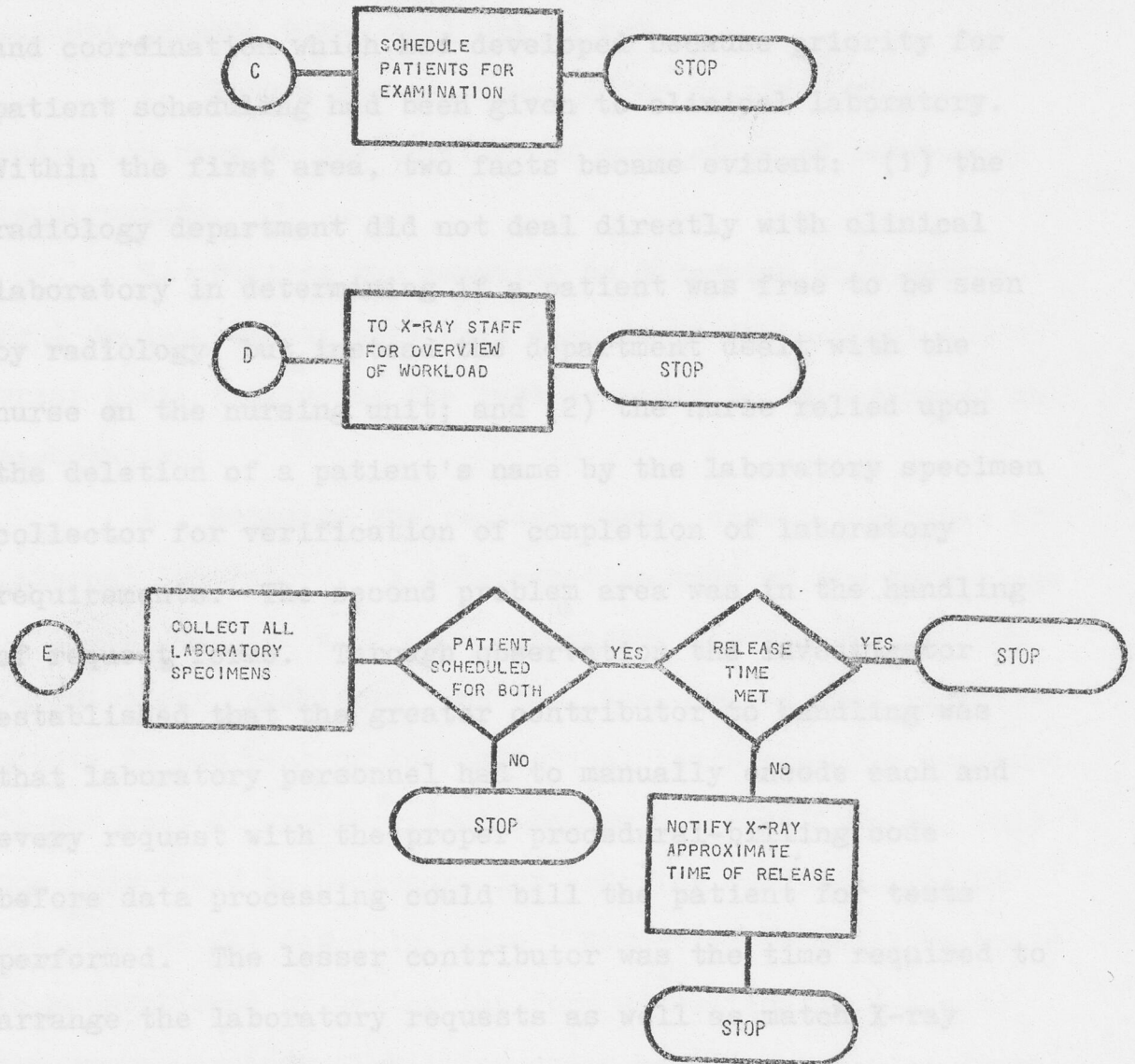


FIGURE 3 FLOW CHART SHOWING IMPROVEMENTS--CONTINUED

Two distinct but interrelated problem areas were identified. The first was the unidirectional communication and coordination between the radiology department and the laboratory for patient scheduling. Within the first area, two facts became evident: (1) the radiology department did not deal directly with clinical laboratory in determining when a patient was free to be seen by radiology staff; and (2) the radiology department relied upon the deletion of a patient's name by the laboratory specimen collector for verification of completion of laboratory



Improvements as determined by the writer that could immediately improve the communication and the coordination between departments and, at the same time, fulfill the criteria, were as follows:

### Summary

Two distinct but interrelated problem areas were identified. The first was the unidirectional communication and coordination which had developed because priority for patient scheduling had been given to clinical laboratory. Within the first area, two facts became evident: (1) the radiology department did not deal directly with clinical laboratory in determining if a patient was free to be seen by radiology, but instead the department dealt with the nurse on the nursing unit; and (2) the nurse relied upon the deletion of a patient's name by the laboratory specimen collector for verification of completion of laboratory requirements. The second problem area was in the handling of request forms. Through observation the investigator established that the greater contributor to handling was that laboratory personnel had to manually encode each and every request with the proper procedural-billing code before data processing could bill the patient for tests performed. The lesser contributor was the time required to arrange the laboratory requests as well as match X-ray request for annotation of patient release times.

Improvements as determined by the writer that could immediately improve the communication and the coordination between departments and, at the same time, fulfill the criteria, were as follows:

hospital 1. Remove the nurse from the interdepartmental communications network by having laboratory assume its rightful responsibility for notifying radiology when patient release times will not be met.

2. Remove the requirement for deletion of a patient's name as the verifier of completion of laboratory requirements.

3. Utilize the computer to determine what department or departments will have demands on the patient and to print lists indicating the test or tests to be performed on each patient.

4. Redesign the request forms, especially those of clinical laboratory. A determination made of the percentage of individual tests of each laboratory service--hematology, parasitology, chemistry, and the like--proved that approximately 20 per cent of the individual tests possible composed 80 per cent or greater of all requests. Additionally, only one form would be necessary for ordering the remaining 80 per cent of all possible tests. Reduction in handling would be accomplished by having the form automatically indicate the proper procedural-billing codes on the preprinted forms. Thus, handling would be reduced to only one form.

Furthermore, two additional phases were suggested in general terms for improving interdepartmental coordination and communication. These phases were based on the concept of centralized scheduling and that, eventually, a total

hospital information system will be evolved for Mobile Infirmary, Mobile, Alabama.

### CHAPTER III

#### CONCLUSIONS AND RECOMMENDATIONS

##### Conclusions

The investigator has concluded that:

1. Within the resources of Mobile Infirmary, Mobile, Alabama, the suggested improvements will better communication and coordination between the departments of radiology and clinical laboratory.
2. The use of automation techniques is the most efficient method for providing this improvement.

##### Recommendations

To assist the administrator in improving the inter-departmental communication and coordination network, the following are recommended:

1. That the requirement for preparation of a separate list of patients scheduled for X-ray and clinical laboratory be discontinued.
2. That the request forms of radiology and clinical laboratory be redesigned to reflect the findings in "Statistical Data."
3. That the miscellaneous form, as shown in Figure 2, be used for ordering tests not already indicated on other

clinical laboratory forms.

4. That the computer-produced listings be initiated.

### CHAPTER III

5. That approximately one year after the initiation of Phase 1 improvements, another study be conducted to further define the improvements suggested for Phases 2 and 3.

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APPENDIX

## FREQUENCY OF LABORATORY TESTS AND X-RAYS

The following illustrations show the numbers of patients for whom were done the various types of laboratory procedures and diagnostic x-rays which are recorded on the PAS Case Abstract.

A total of 131,958 hospital discharges were included in a sample of PAS hospitals—one subsample each from medium-small hospitals (mostly discharging between 5,000 and 10,000 patients a year), medium-large hospitals (mostly 10,000-15,000 patients a year) and large hospitals (mostly over 15,000 patients a year). The sample was chosen simply by selecting from the PAS files, magnetic tapes containing convenient groupings of hospitals. No known bias in the subsamples was introduced by the method. All hospitals are nonfederal short-stay general hospitals. The patients included are those discharged in the period July-December 1962, except delivery patients and births.

### APPENDIX

It should be borne in mind that the number of tests (or x-rays) is as recorded in PAS data: any one kind of test (or x-ray) can be recorded only once for any one patient. Furthermore the same test repeated, except for admission and repeat urinalysis, can not be recorded again. For example, a patient with three prothrombin-time tests would be counted only once in Illustration 4 under "Prothrombin Time" (Column 8).

Of course, the frequencies for an individual hospital may depart widely from the subsample averages. For an extreme example, Illustration 3 shows that serologic tests for syphilis were done for 48.5% of the patients from the medium-large hospitals taken together, whereas the rates for the individual hospitals in this group range from 1.8% to 95.8%.

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### Illustration 1

HEMATOLOGY  
All Patients Except Deliveries and Births  
July-December 1962

Hospitals	Total Patients (1)	Percent of Patients with Hematology (2)	Variety of Hematology Tests Per Patient <sup>1</sup> (3)	Percent of Patients with Specified Kind of Test							
				Bleeding, Coag. Time (4)	Red Cells (Count or HCT) <sup>2</sup> (5)	Hemoglobin <sup>2</sup> (6)	White Cells <sup>2</sup> (7)	Sedimentation Rate (8)	Platelet, Reticulocyte (9)	Red Cell Abnormality (10)	Bone Marrow (11)
12 Medium-Small	28,908	95.6	2.94	8.1	89.4	86.6	90.8	14.0	1.3	0.2	0.3
12 Medium-Large	48,707	94.3	2.94	7.5	86.2	91.9	86.9	16.5	2.9	1.6	0.7
8 Large	54,343	95.8	3.08	8.7	93.7	94.5	92.6	13.4	3.1	0.7	0.8
Total	131,958	95.2	2.99	8.1	90.0	91.8	90.1	14.7	2.6	0.9	0.7

<sup>1</sup> Per-patient average number of kinds of hematology tests marked on the PAS Case Abstract.

<sup>2</sup> A patient recorded as receiving a complete blood count is here treated as having a red cell count, a hemoglobin determination and a white cell count.

### Illustration 2

URINALYSIS  
All Patients Except Deliveries and Births  
July-December 1962

Hospitals	Total Patients (1)	Percent of Patients with Specified Kind of Test <sup>1</sup>				
		Admission Urinalysis <sup>2</sup> (2)	Bile, Urobilinogen (3)	Kidney Function (4)	Hormones (5)	Calcium, Other Mineral (6)
12 Medium-Small	28,908	89.9	0.3	0.3	2.3	0.3
12 Medium-Large	48,707	93.3	0.6	1.0	1.5	0.5
8 Large	54,343	93.2	0.5	1.1	2.0	0.1
Total	131,958	92.5	0.5	0.9	1.9	0.3

<sup>1</sup> "Routine Urinalysis Done Later" is not tabulated because some of the hospitals acknowledge having under-reported this test. However, median percents for this test are as follows: 12 Medium-Small Hospitals - 1.5%; 12 Medium-Large Hospitals - 13.8%; 8 Large Hospitals - 11.2%. Because of the under-reporting, these figures may be smaller than the true medians.

<sup>2</sup> A patient coded as having sugar-positive or albumin-positive urine in his "admission urinalysis" is here treated as having an admission urinalysis, whether or not his PAS Case Abstract was checked for "admission urinalysis done."

### Illustration 3

SEROLOGY  
All Patients Except Deliveries and Births  
July-December 1962

Hospitals	Total Patients (1)	Percent of Patients with Serology (2)	Percent of Patients with Specified Kind of Test							
			Serologic Test For Syphilis (3)	Cross-match (4)	Special Human Antibodies (5)	Bacterial Antibodies (6)	C-reactive Protein (7)	Rheumatoid Factors (8)	Blood Iodine (9)	Heterophile (10)
12 Medium-Small	28,908	46.0	34.0	10.8	0.4	0.6	0.6	0.5	2.2	0.5
12 Medium-Large	48,707	56.3	48.5	12.7	2.2	1.9	1.3	1.0	3.6	1.1
8 Large	54,343	45.8	34.4	11.2	2.7	2.3	1.6	1.0	3.5	1.1
Total	131,958	49.7	39.5	11.7	2.0	1.8	1.3	0.9	3.2	1.0

### Illustration 4

**CHEMISTRY**  
All Patients Except Deliveries and Births  
July-December 1962

Hospitals	Total Patients (1)	Percent of Patients with Chemistry (2)	Variety of Chemistry Tests Per Patient <sup>1</sup> (3)	Percent of Patients with Specified Kind of Test								
				Test for Blood Sugar (4)	Electrolytes (5)	Nitrogen Derivatives (6)	Liver Function (7)	Prothrombin Time (8)	Proteins (9)	Cholesterol, Lipids (10)	Amylase, Transaminase (11)	Electrophoresis, Chromatography (12)
12 Medium-Small	28,908	41.4	1.03	30.3	6.6	30.2	12.4	6.5	4.6	4.8	6.9	0.9
12 Medium-Large	48,707	46.2	1.28	31.1	14.0	34.2	11.8	9.5	7.8	8.8	9.3	1.4
8 Large	54,343	47.6	1.40	35.3	13.8	36.6	12.6	10.9	8.6	9.1	10.4	2.5
Total	131,958	45.7	1.28	32.7	12.4	34.3	12.3	9.5	7.5	8.1	9.2	1.7

<sup>1</sup> Per-patient average number of kinds of blood chemistry tests marked on the PAS Case Abstract.

### Illustration 5

**MISCELLANEOUS LABORATORY TESTS-I**  
All Patients Except Deliveries and Births  
July-December 1962

Hospitals	Total Patients (1)	Percent of Patients with Specified Kind of Test								
		Bacterial Smear (2)	Culture (3)	Antibiotic Sensitivity (4)	Spinal Fluid (5)	Gastric: Chemical, Blood (6)	Stool, for Blood (7)	Stool: Ova, Parasites (8)	Toxicology (9)	Other Body Fluids (10)
12 Medium-Small	28,908	2.3	14.1	9.2	2.1	0.8	3.5	1.9	0.0	0.2
12 Medium-Large	48,707	9.8	24.3	14.0	3.5	1.4	5.4	2.1	0.2	0.7
8 Large	54,343	10.1	19.0	11.9	4.1	1.3	3.8	1.4	0.3	0.5
Total	131,958	8.3	19.9	12.1	3.4	1.3	4.3	1.7	0.2	0.5

### Illustration 6

**MISCELLANEOUS LABORATORY TESTS-II**  
All Patients Except Deliveries and Births  
July-December 1962

Hospitals	Total Patients (1)	Percent of Patients with Specified Kind of Test						
		BMR (2)	Pulmonary Function (3)	EKG (4)	EEG (5)	Papanicolaou (6)	Radioactive Tracers (7)	Frozen Section (8)
12 Medium-Small	28,908	0.7	0.1	18.2	0.9	1.2	0.3	0.1
12 Medium-Large	48,707	1.3	0.6	26.4	2.3	2.4	1.8	0.9
8 Large	54,343	2.0	0.5	27.3	3.6	2.5	2.6	1.1
Total	131,958	1.5	0.4	25.0	2.5	2.2	1.8	0.8

## Illustration 7

X-RAYS  
All Patients Except Deliveries and Births  
July-December 1962

Hospitals	Total Patients (1)	Percent of Patients With X-rays (2)	Variety of X-rays Per Patient <sup>1</sup> (3)	Percent of Patients with Specified Kind of X-ray								
				Survey Chest (4)	Other Respiratory (5)	Skel-etal (6)	Digestive Tract Including GB (7)	Uro-genital (8)	Cardio-vascular (9)	CNS & CNS Spaces (10)	External Soft Tissue (11)	Pleural and Peritoneal Cavities NOS (12)
12 Medium-Small	28,908	58.0	0.88	26.1	17.7	15.4	15.2	8.4	0.4	1.7	0.2	2.6
12 Medium-Large	48,707	60.3	0.99	25.3	19.8	17.0	16.1	10.9	0.9	3.1	0.4	5.2
8 Large	54,343	56.7	0.94	14.0	24.5	19.7	17.4	10.4	2.2	1.6	0.2	4.3
Total	131,958	58.3	0.95	20.8	21.3	18.0	16.4	10.2	1.3	2.2	0.3	4.3

<sup>1</sup> Per-patient average number of kinds of X-rays marked on the PAS Case Abstract.

### Hospitals Included in This Study

**12 Medium-Small Hospitals:**

Defiance, Defiance, Ohio  
Griffin, Derby, Connecticut  
Memorial, Mattoon, Illinois  
Memorial, Owosso, Michigan  
Mercy, Auburn, New York  
Methodist, Madison, Wisconsin  
Miriam, Providence, Rhode Island  
Presbyterian, San Juan, Puerto Rico  
St. Joseph's, Reading, Pennsylvania  
St. Luke's, Marquette, Michigan  
Scripps Memorial, La Jolla, California  
Sisters', Waterville, Maine

**12 Medium-Large Hospitals:**

Emory University, Atlanta, Georgia  
Holy Redeemer, Meadowbrook, Pennsylvania  
Hôpital Général St-Vincent-De-Paul, Sherbrooke, Quebec  
Marion General, Marion, Indiana  
Mary Fletcher, Burlington, Vermont  
Middlesex General, New Brunswick, New Jersey  
Mount Sinai, Chicago, Illinois  
Parkview Episcopal, Pueblo, Colorado  
Roger Williams General, Providence, Rhode Island  
St. Joseph's, Victoria, British Columbia  
St. Luke's, Bethlehem, Pennsylvania  
Springfield City, Springfield, Ohio

**8 Large Hospitals:**

Akron City, Akron, Ohio  
Community, Indianapolis, Indiana  
Miami Valley, Dayton, Ohio  
Misericordia, Philadelphia, Pennsylvania  
Mount Carmel, Columbus, Ohio  
St. Francis, Peoria, Illinois  
St. Margaret, Hammond, Indiana  
St. Mary's, Waterbury, Connecticut

This study is a by-product of a computer tabulation done by the Commission on Professional and Hospital Activities for the Stanford Research Institute, Menlo Park, California.

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A STUDY TO DETERMINE IMPROVEMENTS IN COMMUNICATION AND COORDINATION  
BETWEEN THE DEPARTMENTS OF RADIOLOGY AND CLINICAL LABORATORY  
OF MOBILE INFIRMARY, MOBILE, ALABAMA  
LTC J. A. Farkas  
53 pages August 1969

ABSTRACT

The purpose of this study was to improve communication and coordination between the departments of radiology and clinical laboratory of Mobile Infirmary, Mobile, Alabama.

Two distinct problem areas were studied by the investigator. First, "What are the improvements to the network that could be effected?" and second, "What can be done to reduce the handling of request forms?"

The methodology used in conducting this study was the same for both problems: current health care literature was reviewed, and personal observation of the present network was conducted.

With regard to the first problem, a flow chart was amplified by discussion of the components contributing to the network. The second problem was resolved by recommending redesign of the request forms to reduce handling.