Memorandum

To: Pat Warner; Assistant Administrator Ambulatory Care Services.

From: Project Group for Clinic Utilization Project.

Date: May 1, 1987

Subject: Final report of Clinic Utilization Project.

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The attached report is the final report concerning the Clinic Utilization Project for Ambulatory Care Services. It has been stated repeatedly through the course of this project that the original purpose for implementation was to design and test a methodology that would measure clinic efficiency. This methodology was to eventually be implemented in many if not all of the clinics in Ambulatory Care Services. During the project it was concluded that the goal of implementing one methodology was not obtainable. The reason behind this conclusion was the varying management styles of the different managers in each of the clinics. It was found that many of the clinic managers have different viewpoints concerning what is needed to measure their efficiency and what method should be used to collect and measure it.

As a result of the above conclusion two methodologies were designed and tested; one method in Pediatrics Hematology/Oncology and the other in Orthopedic Surgery. The results of these two studies are too lengthy to summarize here (please refer to the report), but each method was successful in obtaining the information that was intended to be collected. One limiting factor was placed on the analysis of the data; the small sample sizes that were used due to the limited amount of time that was available. Due to these small sample sizes large variances in the data were encountered; the large variances may affect the accuracy of the data. It is suggested that these studies be repeated at a later date to verify the results (larger sample sizes should be taken).

It was observed that many of the the clinics in the University Hospital are having patient flow problems. Considering this, it is strongly suggested that the goals of this project be continued in the future. The strongest recommendation that can be made here is that a productivity monitoring system be developed for Ambulatory Care Services and all clinics and ancillaries be involved in the systems development and implementation. The development and continued use of such a system would allow Ambulatory Care Services to monitor the efficiency the various clinics. If reduced efficiency was indicated for a clinic it would become the clinic managers responsibility to investigate and analyze his/her system to locate any problems.
Ambulatory Care Services
Clinic Utilization Study

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# Table of Contents

Introduction

Background

Pediatrics Hematology/Oncology Analysis
- Scheduled Appts. & Patient Time in Clinic
- Patient Arrival Time
- Percentage of Patients Receiving each Service
- Number of Services per Patient
- Recommendations

Orthopedic Surgery Analysis
- Scheduled Appointments
- Waiting Room
- Examination Rooms
- Doctor Utilization
- Cast Room
- Radiology Turnaround
- Breakdown of Patient Visit
- Recommendations

Conclusions

Appendix A - Original Methodology

Appendix B - Pediatrics Hem/Onc Data

Appendix C - Orthopedic Surgery Data
Introduction

This paper is the final report of the Ambulatory Care Services project conducted by four students in IOE 481. This report will first look into the background of the project, including a statement of the overall purpose, a discussion of several problems that were encountered along the way, and a presentation of the methodologies that were designed. A detailed analysis will be made of the information that was received when these methodologies were tested in two clinics within Ambulatory Care Services. Recommendations that were made for each clinic as a result of these analyses are also presented. Finally, we will draw some conclusions from our project and also present the steps that will need to be taken to reproduce a similar study in other clinics.

Background

The initial purpose of this project was to design and test a methodology that could eventually be applied by each of the clinics within Ambulatory Care Services. This methodology's purpose was to collect and analyze information that would aid each clinic in improving their efficiency. A methodology was designed and proposed that met with this goal (Figure 1, Appendix A).

Through the course of this project, several problems occurred which resulted in wasted time and effort. The first problem concerned the noninvolvement of the necessary clinics from the very start of the project. The severity of this problem was not realized until the proposed methodology was presented to the managers of some of the clinics. At this meeting it became obvious that each manager had independent ideas of what information they desired and the approach that should be taken to obtain this information. It was therefore decided that there was no single methodology that could be applied to all the clinics so two different ones were devised and tested, one in Pediatrics Hematology/Oncology and the other in Orthopedic Surgery.

In Pediatrics Hematology/Oncology, data collection forms were filled out each morning by a staff member, one for each of the patients from the previous day. This form asked for the following information: the scheduled appointment time

- the actual check-in time
- the actual check-out time
- a list of all services/treatments that were provided.

This information was gathered by the staff member by compiling all of the records for each patient onto the one sheet. The staff member was also familiar enough with each of the patients so that she knew the types of treatments the patients were being scheduled for. This knowledge made it easier for her to fill out the forms.
Background (cont'd)
Orthopedic Surgery used a completely different methodology involving the use of eight time-clocks. A separate clock was used to record each of the following times:
- check-in time
- time the patient entered the exam room
- time the doctor went in
- time the doctor came out
- time the patient left the exam room
- time the patient entered the cast waiting room
- time the patient entered the cast room
- time the patient left the cast room.

The "check-in" clock was used at the front desk and the "cast room out" clock in the cast room. The six remaining time clocks were kept together in the cast waiting room. From this location, an observer could watch six exam rooms simultaneously and record when each of the six respective times occurred (for a sketch of the layout of the clinic, see Figure 1, Appendix C).

Both of these methods, as presented above, had distinct advantages and disadvantages. The data collection form method was desirable in that it was less time consuming and could easily be repeated. This method also worked well because of the low volume of patients that Pediatrics Hematology/Oncology schedules per day. Pediatrics Hematology/Oncology averages only 25 patients per day, whereas a clinic with 60-100 patients per day would have too much work for one person to handle. One disadvantage of this method was that the information collected was not detailed; only information such as the number of services per visit and the amount of time spent per number of services could be determined. With a larger sample size, however, it would have been possible to approximate the amount of time spent for each service.

The time-clock study in Orthopedic Surgery also had some unique advantages and disadvantages. As was briefly stated before, the physical layout of this clinic facilitated some excellent data collection. Another advantage was that this method collected a large amount of detailed data. On a negative side, however, this amount of detail also required a large amount of time to perform the analysis. This method was also very time consuming in that the observer had to sit in the cast waiting room with six of the time-clocks and monitor the exam rooms for several hours at a time. During periods of high traffic in the hall, it was often easy to get distracted and miss some of the times. Another possible drawback of this method was that the staff was aware that they were being observed. This may have caused them to make a more conscious effort to perform their duties more efficiently. This type of study could also be undesirable, because the patients would be aware of the data collection.
Analysis of Data Collection in Pediatrics Hematology/Oncology

Data collection in the Pediatrics Hematology/Oncology clinic took place over three days of scheduled clinic hours: Friday April 3rd, Monday April 6th, and Tuesday April 7th, 1987. On Wednesdays and Thursdays the clinic sees mainly non-routine patients. Therefore, Monday, Tuesday, and Friday comprise a week of normal clinic activity. We obtained data from a sample of 73 patients over the three days. See Figure 1 in Appendix B for the data collection form used. The data gathered was analyzed by day, by physician, by scheduled appointment time, and by morning versus afternoon. See Figure 2 in Appendix B for a flowchart detailing patient flow in Pediatrics Hematology/Oncology.

Scheduled Appointments & Patient Time in Clinic

Figure 3 in Appendix B is a histogram of the number of scheduled appointments at each time. There was a higher volume of patients scheduled for the morning which tapered off toward lunch, then a break in the schedule for lunch, then a much lower volume of patients scheduled for the afternoon. The average time of visit length per patient (see Figure 4, Appendix B) was 170 minutes with a standard deviation of 83 minutes. The average time for patients scheduled in the morning was 179 with a standard deviation of 88 from a sample of 53 patients, while the average time for afternoon patients was 145 minutes with a standard deviation of 61 from a sample of 20 patients. With such large variances and small sample sizes this data cannot be conclusive. Although there is an indication towards shorter afternoon visits and lighter scheduling in the afternoon, a repetition of the study with a larger sample would be necessary to prove this hypothesis. From the data collected, this seems to be case. Both of these items make sense due to the complex and time consuming nature of the services performed in the clinic.

Arrival Time

Arrival time of patients did not seem to be a hindering factor. The average arrival time of patients (see Figure 5, Appendix B) was 9 minutes earlier than scheduled with a standard deviation of 43 minutes. One factor affecting this average could be that many of the patients, most of whom visit the clinic frequently (some twice a week), arrive earlier than the scheduled appointment time (some in the range of 2 hours earlier) because they know they will be served when they arrive. Since late times also affect this average, the large standard deviation may be a result partially of patients not keeping their actual scheduled appointments. Again, given the amount of data collected we cannot be conclusive.
Percentage of Patients Receiving Each service
As follows: (See also Figures 6-11, Appendix B).

75% of all patients in our sample received blood draw, 68% of the morning patients, and
95% of afternoon patients.

21% of all patients received broviac draw, 28% of morning patients, and none of the
afternoon patients.

11% of all patients received bone marrow treatment, and did not change from morning to
afternoon.

18% received spinal taps, which did not change from morning to afternoon.

32% received I.V. push chemotherapy, 34% of morning patients, and 25% of afternoon
patients.

15% received I.V. infusion chemotherapy, 17% in the morning, 10% in the afternoon.

The average length of time for infusion chemotherapy treatment per patient was 2.7 hours
with a standard deviation of 1.6 hours, which is a very large range due to the small
sample size of 11 patients.

21% of all patients received other ancillaries or had other appointments, 23% in the
morning, 15% in the afternoon.

The average length of time a patient spent receiving these other services was 1.2 hours
with a standard deviation of .4 hours from a sample of 15 patients.

92% received physical exams, which was consistent throughout the day.

23% received social work consultation, 30% of morning patients, and 5% of afternoon
patients.

There was not enough data to form any ideas on variations by clinic day (data was collected on only
one of each day), by specific doctor (each doctor saw anywhere from only 1 to 13 patients over the
three days observed), nor by specific appointment time (from 1 to 11 patients per scheduled
appointment time over the three days observed). Although the patient sample is still small (53 in
Percentage of Patients Receiving Each Service (cont'd)

the morning and 20 in the afternoon), it seems the afternoon visits may be more routine and less involved on the average than morning visits. However, more data would be necessary to test this theory.

This would seem to make sense in the general scheme, considering it would be advantageous to schedule less complicated visits in the afternoon. However, considering that the number of patients scheduled is already much lower in the afternoon, this may need to be looked at further. It is possible that with the relatively large number of patients scheduled in the morning, many are still being served in the clinic during the afternoon.

Number of Services per Patient Visit

Presumably, the more services provided to a patient, the longer and more involved the visit was. Following are the average visit lengths depending on the number of services provided:

The average number of services per visit was 3 with a standard deviation of 1 (See Figure 12, Appendix B).

For 2 services, the average length of visit was 131 minutes with a standard deviation of 73 minutes from a sample of 23 patients (See Figure 13, Appendix B).

For 3 services, the average length of visit was 157 minutes with a standard deviation of 60 minutes from a sample size of 27.

For 4 services, the average length of visit was 230 minutes with a standard deviation of 97 from a sample of 15 patients.

For 5 services, the average length of visit was 225 minutes with a standard deviation of 62 from a sample size of 8.

In the afternoon, the average number of services provided per patient was slightly lower than in the morning (See Figure 14, Appendix B).

There appears to be a correlation between the length of visit and the number of services provided. However, it is impossible to be conclusive of this or of the actual average length of visit for each number of services provided, given the size of the data set.


**Recommendations**

It is necessary to review the scheduling procedure periodically. It seems that the scheduling of more patients in the afternoon would be favorable to increasing patient throughput. One restricting factor to scheduling patients in the afternoon could be the requirement of a potentially "shorter than usual" next visit. Often the staff are unsure as to the contents of a patient's next visit until he/she actually comes in for their next visit. In any case, the scheduling procedure needs to be one which is standardized among the scheduling clerks. The procedure's effectiveness needs to be evaluated from time to time by a method such as the data collection form we used or by some other method.

A repetition of this study would be potentially easy to do. The data collection form is simple and easy to understand. The data collection per day is not overwhelming since there are only approximately 25 patients each clinic day. The form could be altered slightly or supplemented with additional data if more detail is desired. With the present form, these records could be kept consistently in the computer (scheduling computer, perhaps?). There might be some necessary or desired additions and/or deletions made to the data form for practicality. Keeping these records (or something similar) consistently may even enable the scheduling computer to determine whether an afternoon or morning appointment time would be recommended for this patient.
Analysis of Orthopedic Surgery Clinic Time Study

The time study in Orthopedic Surgery was performed during the week of April 6-10 by a part-time admissions clerk, with the aid of the cast technician and the student group. As stated earlier, eight clocks were used. The study was designed to affect a minimum number of clinic personnel and in a way that would not affect the performance of their other responsibilities. Further, the study was devised in such a way that outside help would be unnecessary during the study, being reserved to setting up the time clocks and analyzing the data. Data was collected during the following half-day clinics: Monday morning Blue Clinic, Tuesday afternoon Maize Clinic, Thursday morning Blue Clinic, Thursday afternoon Hand Clinic, and Friday afternoon Pediatrics clinic. It was deemed necessary to collect times from each of the clinics, though the study captured two Blue Clinic sessions in an effort to study a full day. All figures in the following analysis are found in Appendix C along with a flow chart detailing the patient flow (Figure 2).

Scheduled Appointment Times

Figure 3 is a histogram that shows the distribution of scheduled appointment times versus the time patients actually check in to Orthopedic Surgery. Although the standard deviation of 36 minutes shows a wide dispersal, the average patient arrives one minute before the scheduled check-in time. The large variance could be due to the limited number of patients counted in this study. The majority of patients, however, arrive more or less when expected, meaning that in the analysis of waiting time, time shouldn't be subtracted because patients arrive early.

Figure 4 is a histogram that shows the breakdown of scheduled appointments by time of day. It should be noted that this chart is cumulative for the week, so the morning hours consist of scheduled appointments from a Monday and a Thursday, while the afternoon hours consist of appointments from a Tuesday, a Thursday, and a Friday. Nonetheless, the chart shows a definite increase in the number of patients scheduled as the morning progresses and a slight decrease later in the afternoon. This conclusion specifically indicates that Blue Clinic appears to be scheduling below capacity in the early morning, as both Monday and Thursday are Blue Clinic days. In the absence of other considerations, this suggests that the clinic is not being utilized to its capacity until about 9:45 and after 2:30.

Waiting Room

The waiting room considered here is the outer waiting room. The cast waiting room is considered later. The average amount of time patients wait to enter an examination room, cumulative for the week of observation, is 16 minutes. The standard deviation, however, is 22 minutes with 133 patients in the sample. Again, the small sample size could affect the precision of the analysis.
Waiting Room (cont'd)

The distribution of waiting times given in Figure 5 is lognormal. If it were not for a small number of patients who go right from check in to an exam room, the distribution would be exponential, which is what one would expect for waiting times.

Figure 6 shows the breakdown of average waiting times by clinic studied. The shortest waiting times occurred during Thursday morning Blue Clinic and Friday afternoon Pediatrics Clinic, when patients waited an average of 12 minutes in both clinics. During Thursday afternoon Hand Clinic, patients waited an average of 14 minutes, and during Tuesday afternoon Maize Clinic, patients waited an average of 15 minutes. The reason for the high average waiting time is that during Monday morning Blue Clinic, patients waited an average of 24 minutes in the waiting room. Either this day did not represent a typical Monday, or the Monday morning clinic has a problem relative to the other clinics, suggesting that reasons be found for the discrepancy. Monday aside, the distribution of waiting time by clinic seems rather uniform, as expected. Again, a larger sample of patients would yield more conclusive results.

Figure 7 shows that most patients who go from check in to the cast waiting room do so without first waiting in the outer waiting room. The fact that three patients waited over an hour before entering the cast waiting room may suggest that they were waiting in the wrong place. The small number of patients waiting suggests that one can assume patients go directly to the cast waiting room without waiting in the outer waiting room.

Examination Rooms

According to Figure 8 the amount of time patients spend in an examination room is lognormally distributed, with a mean time of 36 minutes, a standard deviation of 21 minutes, and a sample size of 133 patients. The reason for the distribution is that there is a minimum amount of time a patient can spend in an exam room, determined by the amount of time he/she must wait for a doctor to enter. Once the doctor enters, the visit can be either short or relatively longer.

Figure 9 breaks down exam room time by clinic observed. Notice that patients spent an average of 47 minutes in an exam room on Monday morning and an average of only 22 minutes on Friday afternoon. Further investigation is required to determine reasons for this.

The facility utilization of the exam rooms is calculated by dividing the recorded total time patients spend in exam rooms by the product of the number of rooms observed and the number of available hours, yielding a figure of 57% utilization.
Doctor Utilization

Figures 10 through 18 describe encounters between patients and doctors. Figure 10 shows how long the average patient waits in an exam room before the doctor's first appearance, broken down by clinic. Notice that patients seen during Thursday afternoon Blue Clinic and Friday afternoon Pediatrics Clinic waited an average of 11 minutes for the doctor to enter for the first time, while patients of the other clinics waited between 21 and 23 minutes on average, bringing the cumulative average to 18 minutes. Again, further investigation is needed to determine the nature of these discrepancies.

Once the doctor arrives, he spends an average of 6 minutes with the patient, cumulative for the week, as shown by Figure 11. Figure 12 breaks this down by clinic. Figure 13 breaks down the average number of encounters between a patient and one or more doctors by clinic, which yields a uniform distribution averaging 2 encounters per visit. Figures 14-18 are histograms of the averages of the total time doctors spend with a patient, by clinic.

The calculation of doctor utilization is performed by dividing the total number of exam room doctor hours by the total patient hours spent in the same exam rooms. Figure 19 in Appendix C breaks down doctor utilization by clinic observed. The average for the week is 29%. The lowest utilization was recorded during Monday morning Blue Clinic, when it was calculated to be 20%. The highest, 45%, was recorded by Maize Clinic on Tuesday afternoon.

Cast Room

The only patients that seemed to go to the cast waiting room were patients that needed to see the cast technician immediately following first check in. Patients who needed to see the cast technician after returning from Radiology usually went directly into the cast room or waited in the hall, making the determination of actual waiting time difficult and imprecise. Nonetheless, Figure 20 yields an average waiting time of 14 minutes, distributed exponentially. Figure 21 shows that once the patient enters the cast room, the average service time is 19 minutes. The patient sample in both of these charts is 47.

Radiology Turnaround

As there is much interest in the amount of time patients spend away from Orthopedic Surgery, the survey yielded an average time of 56 minutes, using a sample of 60 patients (see Figure 22, Appendix C). The distribution is roughly normal, but more data is needed to form a better plot.
Summary of Previous Given Data

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<th>4/7 PM</th>
<th>4/8 AM</th>
<th>4/9 PM</th>
<th>4/10 PM</th>
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*All times are given in minutes.

Breakdown of Patient Visits

Figures 23-25 breakdown specific types of patient visits by the percentage of time they spend in each stage of their visit. Figure 23 breaks down the simple exam room visit, showing that the average patient spends 31% of his time in the waiting room and 69% of his time in an exam room. Only 23% of the visit, however, is spent with a doctor. Figure 24 breaks down cast room visit, showing that the average patient is in the cast waiting room 23% of the visit, in the cast room 31% of the visit, and at Radiology for 46% of the visit. Figure 25 combines the two, giving percentages for complex visits.

Recommendations

Repetition of this study on a larger scale should be considered in order to receive more conclusive data. The sample of patients is relatively large when considering the the week as a whole, but becomes increasingly inaccurate when one attempts to analyze data by clinic. Still, some strong indications were yielded by the data concerning scheduling, patient waiting times, visit times, and doctor utilization.

In the absence of other considerations, Figure 4 shows that the clinics are not scheduled to their apparent capacity early in the morning or later in the afternoon. The clinic needs to investigate whether it can increase patient throughput by increasing the number of scheduled appointments during these times. Patient waiting times in both the waiting room and exam rooms before the
Recommendations (cont'd)

doctor enters are included in the report, as are cast room times and the average amount of time patients spend at Radiology. Because a literature search proved fruitless, the student group has no way to gauge whether these results are acceptable or not. The clinic, therefore, must make its own judgment. Given the variance between individual clinics, it would seem that comparisons should be made to determine reasons for the discrepancies.

Doctor utilization varied between 20% and 45%, averaging 29%. Investigation is needed to determine whether this percentage is justified or whether it can be improved. In short, this study provided an indication of what happens when patients visit Orthopedic Surgery, and the management now needs to investigate why. Regardless of whether problems are discovered and corrected, this study should be repeated at a later date, subject to the discretion of the management, and preferably on a larger scale, to observe if any change has occurred.
Conclusions

The conclusions that have been drawn from this project are not based specifically on the analysis or recommendations that have been presented for the two methodologies. Instead, the conclusions that have been drawn are based on what the overall purpose of the project was when it was originated.

The original purpose for implementing this project was to design and test a methodology that would measure clinic efficiency. Once tested and approved this methodology was to be implemented in all of the clinics of the University Hospital's Ambulatory Care Services Department. What follows is review of the problems that were encountered during the course of this project and an general outline detailing the steps that should be followed to implement a study. If followed, this outline will aid Ambulatory Care Services in minimizing the problems that arose during this study.

Review of Problems

1) The necessary clinics were not involved from the beginning of the project. Some definite difficulties arose when attempts were made to involve the clinics that were believed to be interested in participating in this project. This problem hindered the decision making process and brought on stringent time constraints near the end of the project. All attempts should be made to avoid this problem in the future; without the necessary input no project can obtain its goals.

2) One methodology may not be applicable to all clinics. This may not appear to be a problem to some but, due to nature of the project and the existence of the previous problem this problem became definite. During the course of this project it was observed that most clinic managers do not need or want the same information as other clinic managers. It was also observed that each clinic is not managed in a way that would facilitate the use of one methodology. Some clinics may need a tailored methodology and others may be able to utilize similar methodologies.

Implementation of Studies

The following outline has been devised to facilitate the implementation of any similar future project that Ambulatory Care Services may wish to implement.

1) Involve all necessary staff from the start of the project.
Implementation of Studies (cont'd)

2) Make a decision concerning the type of information that is needed.
3) Conduct a literature search.
   Information concerning similar successful studies may be helpful in implementing the current project.
4) Design a methodology to collect the desired information.
   What types of data collection tools are available and/or applicable?
   Can the current staff collect the data or is outside help needed?
5) Implement the study.
   Test the data collection for a set time period so that any problems can be remedied.
   Collect enough data to insure that the results will be statistically significant!
6) Analyze the data.
   What do the results show about the desired information?
   What other information, if any, do the results show?
7) Report findings and recommendations.

The above points may seem obvious but it can not be said that they are too obvious considering the problems that were faced during the course of this project.

It was observed that many of the clinics in the University Hospital have some serious patient flow problems. Considering this, it is strongly suggested that the goals of this project be continued in the future. The viewpoint of this project group is that there is not one perfect way to manage an ambulatory clinic. But, it is also the group's view that each manager should do all that is possible to obtain information concerning their patient flow and efficiency so as to eliminate their flow problems and improve their efficiency.
Appendix A
Original Methodology
Please feel free to make any additions, subtractions, or comments that you feel will improve upon any of the following points of discussion.

I. Data Collection:
   A. What type of method should be used?
      Our current proposal is to use a patient survey collection form. This form would be given to the patient upon check-in. The patient would fill the survey out during his/her visit and turn it in upon checking-out.
   
   B. Should the patients fill out the data collection form?
      Our current proposal calls for the patients to fill out the collection form. This was viewed as the best way to keep the workload off of the clinic staff and to collect a more detailed response.
      1. Are the instructions and patient survey patient-friendly?
      2. Will the patients fill out the survey?
      3. If needed can the clinic staff be counted on to aid the patient in filling out the survey?
   
   C. Should X-ray and Blood Draw be included in the survey?
      We would like to include X-ray and Blood Draw in the survey. This would present a more detailed view of what patient waiting times are.
      1. Will this confuse the patient?
      2. Will X-ray and Blood Draw give the input that is necessary?

II. Clinic Derived Data:
   A. Our current proposal calls for the clinic staff to derive the following estimates:
      1. The actual time the provider spends caring for a patient.
      2. Target values for the time the provider spends caring for a patient.
   
      This information would be used, along with the information supplied on the collection forms, to calculate room utilization figures. The clinic derived information would need to be generated concurrent with the collection of other data to insure the timeliness of all relative information.
   
   B. Can close estimates for this information be derived?
   C. Will the estimates be fair and unbiased?
   D. Do the clinics want (or need) Management Systems help in deriving the figures.
III. Results:

A. The results of this study will be supplied to Ambulatory Care Services Administration and to the involved Clinic Administrator.

1. Should the data be supplied to anyone else?

B. Our current methodology will supply data that can be used to produce the following information:

1. Distributions of time spent in each type of room.
   a. What types of room groupings would be helpful?

2. Distribution of scheduled arrival time v. actual arrival time.

3. Distribution of time spent parking.
   a. Can the information supplied by the patients be used or do we need to do a simulation of the parking area using the data supplied by parking?

4. Distribution of time spent registering obtained from data supplied by registration.
   a. If possible should this be calculated by the time of day?

5. Chart (graph) of time (also % of time) spent by the patient during the clinic visit (ie. where the patient spent his time).

6. Comparison of the patient time spent in the room with the actual provider time spent in the room (ie. the current room utilization).

7. Comparison of the patient time spent in the room with the target provider time spent in the room (ie. the target room utilization).

8. Patient throughput using actual provider time. This data would be verified with patient scheduling information from the clinic.

9. Patient throughput using the target provider time.

10. Patient throughput with operating schedule changes (ie. Schedule patients through the lunch hour and/or extend hours of operation).
Appendix B
Pediatrics Hem/Onc Data
Figure 1

Patient Services in Pediatrics Hematology/Oncology

Please fill in the requested times for each patient and check the boxes that correspond to the services provided.

Date of Service

Scheduled Appointment Time

Actual Check In Time

Check Out Time

Physician's Name

Place Stamp in Box

Services Provided

Blood Draw?

Broviac Draw?

Bone Marrow Treatment?

LPs (Spinal Tap)?

I.V. Push Chemo?

I.V. Infusion Chemo?  No. of Hours if Applicable?

Did Patient Have Other Appointments/Ancillaries?  Number?

Physical Examination?

Social Work Consultation?

Dressing Change Demo for Parent?

Eight-Hour Study?

Ped. Surg. Consult or Suture Removal in Clinic?
Patient Flow in Pediatrics Hematology/Oncology Clinic

CHECK-IN

YES
Will this sample be taken in blood draw?

NO
INFUSION ROOM

YES
Need a blood sample?

NO

YES
Need any other ancillary?

NO
BLOOD DRAW

OTHER ANCILLARY

WAITING ROOM

YES
Did patient come from ancillary?

NO
NURSE STATION

EXAM ROOM

1 2 3 4 5 6 7
Figure 2

Patient Flow in Pediatrics Hematology/Oncology

1. Need a blood sample?
2. Need any other ancillary?
   - YES: Need a treatment?
     - YES: TREATMENT ROOM
     - NO: Does the treatment need to be finished in the clinic?
       - YES: INFUSION ROOM
       - NO: CHECK-OUT
   - NO: CHECK-OUT
3. Need a blood sample?
   - YES: Need a treatment?
     - YES: TREATMENT ROOM
     - NO: Does the treatment need to be finished in the clinic?
       - YES: INFUSION ROOM
       - NO: CHECK-OUT
4. Need a blood sample?
   - YES: Need a treatment?
     - YES: TREATMENT ROOM
     - NO: Does the treatment need to be finished in the clinic?
       - YES: INFUSION ROOM
       - NO: CHECK-OUT
5. Need a blood sample?
6. Need a blood sample?
7. Need a blood sample?
Figure 2
Patient Flow in Pediatrics Hematology/Oncology

Need any other ancillary?

EXIT CLINIC
Pediatrics Hematology/Oncology

# Patients Scheduled

Scheduled Appointment Time
Figure 4

Histogram of $X_1$: Patient Time in Clinic (min)

N=73  AVG=170  STD DEV=83
Histogram of $X_1$: Actual Arrival Time v. Scheduled

Count

Actual Arrival Time v. Scheduled

$N=73$  $AVG= -9$  $STD \, DEV= 43$
PERCENTAGE OF PATIENTS ON EACH DAY WHO WERE PROVIDED WITH EACH SERVICE

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*Number of patients
### Figure 7

**PERCENTAGE OF PATIENTS AT EACH SCHEDULED APPOINTMENT TIME WHO WERE PROVIDED WITH EACH SERVICE**

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**TOTALS**

|            | 75%        | 21%       | 11%       | 18%      | 32%       | 15%         | 2.73 | ±1.60            | 21%    | 1.20     | 92%      | 23%       | -9     | 170     | ±83    |

*Number of patients
### PERCENTAGE OF PATIENTS SEEING EACH DOCTOR WHO WERE PROVIDED WITH EACH SERVICE

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**TOTALS**

|         | 75%        | 21%           | 11%  | 18%  | 32%           | 15%          | 2.73       | 21%     | 1.20           |
|         |            |               |      |      |               |              | ±1.60      |         | ±83           |

*Number of Patients
Pediatrics Hematology/Oncology

Fraction of Patients Receiving Treatment

![Bar Chart]

Treatments (Morning)
Figure 12

Pediatrics Hematology/Oncology

Histogram of Number of Services

Frequency

# Services

0 2 3 4 5

25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
Pediatrics Hematology/Oncology

Average time vs. # of Services

Average Length of Visit

# Services

Figure 13
Figure 14

Pediatrics Hematology/Oncology
Average #Services by Appointment Time

Appointment Time

<table>
<thead>
<tr>
<th>Time</th>
<th>Average # of Services/Pl.</th>
</tr>
</thead>
<tbody>
<tr>
<td>830</td>
<td>3</td>
</tr>
<tr>
<td>1030</td>
<td>3.5</td>
</tr>
<tr>
<td>1230</td>
<td>4</td>
</tr>
<tr>
<td>1430</td>
<td>2</td>
</tr>
</tbody>
</table>
Appendix C
Orthopedic Surgery Data
Floor Plan of Orthopedic Surgery
Figure 2
Patient Flow in Orthopedic Surgery

CHECK-IN

Need a cast removed?
YES
CAST WAITING ROOM

CAST ROOM

NO

Already have an X-ray slip?
YES
X-RAY

NO
MAIN WAITING ROOM

EXAM ROOM

Need an X-ray?
YES

Need a cast?
YES

CHECK-OUT

NO

Need an X-ray?
YES

NO
Orthopedic Surgery
Actual vs. Scheduled Arrival Times (min)

Frequency

Act. v. Sched. (avg = -1; std dev = 38; N = 108)
Figure 5

Orthopedic Surgery
Waiting Room Times (min)

Waiting Times (avg=18; std dev=22; N=133)
Orthopedic Surgery Waiting Room Times

Avg. Time in Waiting Room

Clinic Date

4/6 a.m.  4/7 p.m.  4/9 a.m.  4/9 p.m.  4/10 p.m.  Total avg.
Figure 7

Orthopedic Surgery

Waiting Times Before Cast Waiting Room

waiting Time (min): avg = 2, dev = 24, N = 47
Orthopedic Surgery

Exam Room Times

Frequency

Room Time (min) (avg=38; std dev=21; N=133)
Orthopedic Surgery Exam Room Times

Clinic Date

4/6 a.m. 4/7 p.m. 4/9 a.m. 4/9 p.m. 4/10 p.m. Total avg.

Avg. Time in Exam Room

0 10 20 30 40 50
Orthopedic Surgery First Encounter Times

Clinic Date

Avg. Time to First Doctor Encounter

4/6 a.m. 4/7 p.m. 4/9 a.m. 4/9 p.m. 4/10 p.m. Total avg.
Figure 11
Orthopedic Surgery
Doctor Time Spent W/Patient/Encounter

Frequency

Doctor Time (min) (avg=6; std dev=4; N=203)
Orthopedic Surgery Encounter Times

Avg. Time Dr. Spends w/ Pt. per Encounter

Clinic Date

4/6 a.m. 4/7 p.m. 4/9 a.m. 4/9 p.m. 4/10 p.m. Total avg.
Orthopedic Surgery Doctor Enc. per Patient

<table>
<thead>
<tr>
<th>Clinic Date</th>
<th>Avg. # of Encounters per Patient</th>
</tr>
</thead>
<tbody>
<tr>
<td>4/6 a.m.</td>
<td>2</td>
</tr>
<tr>
<td>4/7 p.m.</td>
<td>1</td>
</tr>
<tr>
<td>4/9 a.m.</td>
<td>1</td>
</tr>
<tr>
<td>4/9 p.m.</td>
<td>2</td>
</tr>
<tr>
<td>4/10 p.m.</td>
<td>2</td>
</tr>
<tr>
<td>Total avg.</td>
<td>2</td>
</tr>
</tbody>
</table>
Orthopedic Surgery
Doctor Time Spent With Patient

Time (min) (April 8, 1987; Morning)

Frequency

Figure 14

48
Figure 15
Orthopedic Surgery
Doctor Time Spent With Patient

Frequency

Time (min) (April 7, 1987; Afternoon)
Figure 16

Orthopedic Surgery
Doctor Time Spent with Patient

Time (min) (April 9-8, 1987; Morning)
Figure 17

Orthopedic Surgery
Doctor Time Spent With Patient

Time (min) (April 9, 1987; Afternoon)

Frequency
Orthopedic Surgery

Doctor Time Spent With Patient

Time (min) (April 10, 1987; Afternoon)
Orthopedic Surgery Doctor Utilization

Clinic Date

Dr. Time in Exam Rm./Patient Time in Rm.

0.5
0.4
0.3
0.2
0.1
0.0

4/6 a.m. 4/7 p.m. 4/9 a.m. 4/9 p.m. 4/10 p.m. Total avg.
Figure 20

Orthopaedic Surgery
Most Waiting Room Times

Waiting Time (min) (avg=14; dev=15; N=47)
Orthopedic Surgery
Cost Room Times

Waiting Time (min) (avg = 19; dev = 12; N = 47)
Orthopedic Surgery

X-Ray Turnaround Times

X-Ray Times (min) (avg=58; dev=23; N=80)
Orthopedic Surgery
Breakdown of Patients Only Seeing Dr.

DR (23.0%)

WT RM (31.0%)

EXAM (48.0%)
(without physician)
Orthopedic Surgery
Breakdown of Cast Room Visits

CWR (23.0%)

XRAY (46.0%)

CAST (31.0%)
Orthopedic Surgery
Breakdown of an Extensive Patient Visit

CAST (10.0%)
CWR (7.0%)
X-RAY (29.0%)
DR (12.0%)
WT RM (17.0%)
EXAM (25.0%)
(without physician)