Analysis of Lead Time for The Division of Nephrology

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The Simulation of Propagation

Propagation Models

Propagation Models

Simulation and Calculation
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Executive Summary

Introduction

At the request of the Division of Nephrology, the new patient lead time for the Nephrology clinic has been analyzed. This analysis has been completed by the student Project Team of Jonathan Brinks, Brian Cross, and Robert Larsen. The student project team has been working with Elizabeth Othman, Senior Analyst for the Program and Operations Analysis department at the University of Michigan Hospital.

The purpose of this analysis is to provide the Division of Nephrology feedback on patient lead times, to provide them with a reference point for future analysis and to aid them in making improvements in the Nephrology clinic. The purpose of this report is to inform you of the approach and methodology for this analysis and to provide the results of our analysis.

The new patient lead time for the Division of Nephrology has been defined as the period of time between the patient's appointment date and the date when the patient called the hospital to schedule the appointment. This scheduling is done by the Internal Medicine Scheduling department at the University of Michigan Hospital.

Conclusions

The main conclusion from our analysis of the Nephrology clinic new patient lead time is that the lead times is directly related to the number of slots the clinic closes. If the clinic would like to reduce the new patient lead times, the most effective way may be to eliminate the closings of new patient slots. As shown by Figure 5, the lead time in October dropped after the number of closings in September and October was very low.

The second conclusion from our analysis is that the number of no-shows is constant, at about 7%, and is not related to the lead time. Combined with the cancellation and rescheduling data, there is more than 30% of patients that don’t keep their scheduled appointments. With this in mind you can overbook the clinic, unless your resources are already maximized with four new patient slots.

A third conclusion is that patients are more likely to keep an afternoon appointment. Based on this fact, increasing the number of afternoon appointments would make the Nephrology clinic more predictable. The data showed that the Tuesday clinic had a utilization of 81%. This means that of the scheduled appointments for Tuesday, 81% of the patients showed up for their appointments. Tuesday is the clinic day with afternoon appointments.

The final conclusion of our analysis is that there is a higher demand for Monday and Tuesday appointments. If it is possible, increasing the number of slots available for use on Monday and Tuesday would help meet the patient demand better, thereby reducing lead time and lost business.
Finally, throughout our analysis of the Nephrology clinic the charts that were most useful in analyzing the data were:

- Number of appointments each month with lead time contributions (Figure 2)
- Average lead time by week vs. new patient slot closings by week (Figure 5)

Using these two charts to keep track, week by week, of lead time the clinic will be able to notice any trends in the lead time. The first chart (Figure 2) will keep track of the lead time contributions for total appointments. The second chart (Figure 5) will keep track of lead time and new patient slot closings.
Introduction

At the request of the Division of Nephrology, the new patient lead time for the Nephrology clinic has been analyzed. This analysis has been completed by the student Project Team of Jonathan Brinks, Brian Cross, and Robert Larsen. The student project team has been working with Elizabeth Othman, Senior Analyst for the Program and Operations Analysis department at the University of Michigan Hospital.

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The new patient lead time for the Division of Nephrology has been defined as the period of time between the patient's appointment date and the date when the patient called the hospital to schedule the appointment. This scheduling is done by the Internal Medicine Scheduling department at the University of Michigan Hospital.

For each day that the Nephrology clinic operates there are four new patient slots available for use. Whenever there are doctors absent from the clinic, some of these new patient slots are closed. The reason for this is to make sure the clinic does not become overburdened. The Nephrology clinic informs the Internal Medicine Scheduling department of these closings so that patients are not scheduled for those slots. These closings are usually scheduled one to two months in advance.

This project focuses only on new patients for the Division of Nephrology and does not include patients who have previously been seen within the Division of Nephrology. The reason for this is that return patients lead times are affected by the length of time the doctor specifies before the next appointment, and this variation cannot be accounted for in the data.

Approach and Methodology

The first step in analyzing the lead times was to obtain the data for new patient scheduling from the University of Michigan Hospital. This step was facilitated by Elizabeth Othman. The data was originally in a Microsoft Word document with the data fields delimited by comma's. We imported this document into Microsoft Excel using Excel’s built in features.

The data fields included in this document were as follows:

- Patient last name
- Patient first name
- Patient home address
- Status of patient appointment
- Date patient scheduled the appointment
- Date of the appointment
- Date appointment was canceled (if it was canceled)
- Resource code (doctor or department seeing the patient)
Next, we talked with Bonnie Welliver, RN Case Manager, at the Nephrology clinic to see what she thought of the project and to get some ideas of what she might expect out of this analysis. It was discovered that she was in the process of collecting data to analyze the new patient lead times. She provided us with this data, which included the number of new patient slots closed for each day of operation.

The next step in analyzing the data was to eliminate the data not needed for this analysis. The Division of Nephrology was only interested in recent patient lead times so the data prior to July 14, 1995 was eliminated. This date was selected as the cutoff point because that is when the Nephrology clinic started keeping track of the number of new patient slots closed.

After narrowing the data down to the specified dates, the next step was to eliminate data outliers. The first step was to calculate the lead time for each patient. This was a simple process using Excel to find the difference between the patient’s appointment date and the patient’s scheduling date. After this was completed the average and standard deviation for lead time was calculated with Excel. After these calculations any patient lead times that were outside of three standard deviations was eliminated from our analysis.

Next, we decided to analyze the data in two formats. The first format was to analyze the lead times for the entire clinic. The second format was to analyze the lead times for each individual clinic day. The Nephrology clinic is open only on Monday, Tuesday, Wednesday, and Friday.

The lead times for the entire clinic were analyzed in the following ways:

- Monthly average lead time
- Appointment status contribution to lead time
- Weekly lead time Vs. new patient slots closed

The lead times for the individual clinic days were analyzed in the following ways:

- Number of new patient slots closed
- Slot utilization
- Overall averages
- Monthly averages
- Appointment status contribution to lead time

There are four appointment status types for the Nephrology clinic and they are as follows:

- No-show - Patient does not show up or call
- Cancel - Patient calls in and cancels appointment (even after the scheduled time)
- Re-scheduled - Patient calls in and reschedules their appointment
- Appointment Kept - Patient shows up for the appointment

**Results**
Entire clinic results

These results are for the analysis of the data for the overall clinic operations. They show how well the clinic is operating overall. The overall monthly averages for the new patient lead time are shown below in Figure 1. It appeared that there was a change in new patient lead times at the beginning of October, so we calculated the overall average for the three months prior to October, and the five months after October.

![monthly averages for new patient lead times](image)

**Figure 1.** Overall monthly average lead times. The line shows the overall average for the three months prior to October (16.7) and the five months after October (11.83). The total number of patients seen each month is shown in parenthesis.

The number of appointments scheduled each month is fairly stable as shown in Figure 2 on the following page. The number of appointments with a lead time of less than one week varied a lot. In October, the number of appointments with a lead time of less than one week reached a peak. After October the number of appointments with less than a one week lead time fell, but to the levels before October. Also the number of appointments with a lead time of greater than three weeks fell in October.

This shows once again that something that occurred in October drove the lead time down, and after October the lead times went up, but not to the previous levels.
The number of cancellations increased dramatically as the length of lead time increased. Figure 3 below shows that with a lead time of less than one week, 74% of patients keep their scheduled appointment. As lead time increases to greater than three weeks, only 50% of the patients keep their scheduled appointments.

The number of no-show patients is fairly constant at approximately 7% of the scheduled appointments. As lead time increases the number of cancellations increase. What this shows is that the longer the lead time, the more lost business (no-shows + cancellations)

Figure 2. Number of Appointments by month, broken down into the length of lead time.

Figure 3. Percentage of each type of appointment status for the different lead time intervals.
Figure 4 below shows the percentage breakdown of the lead times for new patients. Almost 40% of new patients have to wait more than two weeks to get an appointment. If the Nephrology clinic wants to improve customer satisfaction and decrease the amount of lost business they will have to decrease the percentage of patients that have to wait more than two weeks for an appointment.

Figure 4. Percentage breakdown of new patient lead times.

Figure 5. The relationship between average lead time and number of new patient slot closings by each week.
The relationship between lead time and the number of new patient slots closed is shown in Figure 5 on the previous page. This is one of the key findings of our analysis. This graph shows that when the number of new patient slot closings goes up the average lead time goes up for the week or two after that increase. The same holds true for a decrease in the new patient slot closings.

This result is important in that it explains the decrease in average lead time during October. Looking at the number of new patient slot closings during September and October we noticed that there were very few closings and during this time the average lead time fell.

**Individual clinic day results**

This section of the results is for the analysis of the data for the individual Nephrology clinic days. The overall average for each clinic day is show in Figure 6 below. This chart shows that from July 1995 to February 1996 the overall average lead time was 13.8. It also shows that Monday and Tuesday clinic patients had to wait two to three days longer than the patients with appointments on Wednesday or Friday. One possible reason for this is that patients would rather have their appointments early in the week. Also, Tuesday is the only clinic day that has afternoon appointment slots for new patients.

![Average Lead Time for each Clinic Day (Jul 95 - Feb 96)](image)

**Figure 6.** Average Lead time for each clinic day for July 95 to February 96.

As was mentioned earlier, during October the overall average lead time dropped almost 2 days. Because of this change we decided to see if there was a difference in the individual clinic days from October to February. Figure 7 on the following page shows that the average lead time for each clinic day also dropped almost two days. It also shows that the Wednesday and Friday clinic days still have a significantly lower lead time than the Monday and Tuesday clinic days.
Figure 7. Average lead time for each clinic day for October 95 to February 96.

After seeing the higher lead times for Monday and Tuesday we thought that maybe the reason behind the higher lead time was that there were fewer appointments available on Monday and Tuesday. If Monday and Tuesday had more slots closed then the lead time to get appointments on those days would be higher. Figure 8 below shows that the opposite is true. Wednesday and Friday actually had more new patient slot closings, and therefore fewer available slots than Monday or Tuesday.

Figure 8. Total number of new patient slots closed for July 95 to February 96.
The next thing we looked at was how many of the available new patient slots were actually used for each clinic day. To determine the number of slots used we found the number of patients that kept their appointments and divided by the total number of slots available for scheduling. To determine the total number of slots available we took the four new patient slots for each day and multiplied by the number of days the clinic was open. After doing that we subtracted the total number of new patient slot closings. Figure 9 below shows that Tuesday had the highest slot utilization. This is probably because the Tuesday slots are scheduled in the afternoon and it is easier for people to make it to an afternoon appointment.

![Slot Utilization by Clinic Day](image)

Figure 9. Slot utilization for each clinic day.

Finally as a test of the lead time to get an appointment for the Nephrology clinic, we called the Internal Medicine scheduling desk and asked to set up an appointment. When we requested an afternoon appointment we were told that the soonest available appointment was 22 days from when we called. When we requested a morning appointment we were told that the soonest available appointment was 12 days from when we called. This shows that the actual lead time to get an appointment is fairly long and not just related to patient preference.
Conclusions and Recommendations

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Slot Utilization by Clinic Day

- Monday: 0.73
- Tuesday: 0.81
- Wednesday: 0.65
- Friday: 0.61
Total # of Closings for Each Clinic Day

- Mon: 21
- Tue: 13
- Wed: 26
- Fri: 33
### Average Lead Time for each Clinic Day (Jul 95 - Feb 96)

<table>
<thead>
<tr>
<th>Clinic Day</th>
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<th>2.00</th>
<th>4.00</th>
<th>6.00</th>
<th>8.00</th>
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<th>12.00</th>
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<tbody>
<tr>
<td>Mon</td>
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</tbody>
</table>

The chart above illustrates the average lead time for each clinic day between July 1995 and February 1996.
Monthly Averages - Overall

<table>
<thead>
<tr>
<th>Month</th>
<th>Average Lead Times</th>
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</tr>
</thead>
<tbody>
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</tr>
<tr>
<td>Aug</td>
<td>18 (n=58)</td>
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<td>Sep</td>
<td>16 (n=70)</td>
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<tr>
<td>Oct</td>
<td>14 (n=72)</td>
<td></td>
</tr>
<tr>
<td>Nov</td>
<td>16 (n=54)</td>
<td></td>
</tr>
<tr>
<td>Dec</td>
<td>14 (n=49)</td>
<td></td>
</tr>
<tr>
<td>Jan</td>
<td>12 (n=65)</td>
<td></td>
</tr>
<tr>
<td>Feb</td>
<td>12 (n=59)</td>
<td></td>
</tr>
</tbody>
</table>
Appointment Status by Lead Time

% of each Appt. Status

- No-Show
- Cancel
- Resched.
- Kept

Lead Time

- < 1 Week
- 1-2 Weeks
- 2-3 Weeks
- > 3 Weeks