Maximizing Therapy Order Throughput by Improving a Hospital Scheduling Process

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Abstract
A hospital in the Northern Illinois region is finding complications with handing the scheduling of the number of patients that are coming into a clinic. This hospital asked the Department of Industrial and Systems Engineering at Northern Illinois University to help find ways to maximize the throughput of patients within a process of physical therapy (PT) and occupational therapy (OT) evaluations and follow-up appointments. This project resulted in small proposed improvements as well as a scheduling tool deliverable.

Introduction

Inpatient therapy is a service received by patients typically after a surgical operation. An order for physical or occupational therapy is entered in the hospital system. As the therapy clinic is receiving patients that need evaluations or appointments, at present a manual scheduling process struggles to meet demand of a backlog of patients, resulting in unnecessary extended patient stays. Patients are required to complete an initial comprehensive evaluation where a treatment plan of any necessary follow-up sessions are determined. At present, the scheduling of these appointments is a manual-entry process performed by a staff nurse. Due to time, labor, and technological constraints, the nurse’s ability to schedule appointments is limited to planning only the morning appointments. Within this process, evaluations are the number one priority in scheduling open appointment times.

Problem Statement

Several key issues are driving consequences to both the hospital and patient stakeholders. Most noticeably, the therapist labor resources are understaffed to manage the large volume of orders. Unpredictable factors may cause a patient to be late to their appointment or miss it entirely, interrupting the therapists’ schedule of orders. Evaluations are prioritized over every follow-up, leading to patients through the system. This displays as an imbalance between staff members consciously mislabeling follow-up appointments to push long-waiting patients through the system. This displays as a trade-off between increasing/decreasing evaluations and follow-up appointments, further backlogging the system.

Project

The goal of this project was to develop a scheduling tool for hospital staff that given input patient data will suggest a daily priority of physical therapy and occupational therapy appointments. By helping to automate an otherwise manual, non-value-adding process, a scheduling tool will help to cover an entire day shift of appointments. Following a software development life cycle (SDLC) project approach, the team reached a consensus on user requirements, goals, and deliverables; performed analysis on historical trends and data collection; used simulation techniques to test proposed improvements against a model of the current state process; and ultimately developed a tool which could be implemented by hospital staff to maximize the number of appointments seen in their inpatient therapy department.

Project Scope

The scope includes the process from order creation thru when the order is closed out. This project only focuses on physical therapy and occupational therapy. It does not include discharge rates and patient health background that lead to therapy.

Methodology

Data Analysis

Provided 1 year of empirical data collection from the hospital’s EMR system, Epic. The project team adopted a simulation project approach that would best suit testing improvement policies against a model of the current state system. Order interarrival times were calculated using Microsoft Power Query with the intent to fit statistical distributions that could be recognized by the simulation’s create model. In preliminary statistical tests, order interarrival times for PT and OT orders failed to fit any statistical distributions. Therefore, a trend analysis using Tableau was executed to highlight areas of the data could be further divided which may succeed in fitting distributions. Noticeably orders were both created and ended at consistently higher rates weekdays Monday-Thursday. Similarly, orders were created most frequently during working hours 7am-6pm. The interarrival data was then further queried, dividing interarrival time by Order Type PT vs OT, Weekday (Mon-Thur) vs Weekend (Fri-Sun), and Working Hours vs Non-Working Hours which are specified by staff physical and occupational therapists’ work hours for a total of 8 unique combinations. Chi-square goodness of fit testing was used to validate whether the empirical data samples could be represented by Weibull, Lognormal, Exponential, or Gamma distributions.

Simulation Modeling

Before creating a simulation, the understanding of how the hospital’s patients experience this project is important. The process for each patient, no matter the type, will go through a similar process of coming in for therapy, being evaluated, having follow-up sessions if needed, and then leaving.

Economic Analysis

Using the current state simulation, the team was able to run the possibilities of adding more staffed therapists in order to see how much profit will be made. By using the state average of PT appointments being $187.50 and OT appointments being $225, the team can show annual profit after paying the staff members an estimated annual pay of $80,000 for PTs and $52,000 for OTs.

Results and Conclusions

Tested Proposed Improvements

Throughout the process of this semester, different types of improvements were thought of to aid in the increase of throughput for this hospital. Since the hospitals current state is scheduling appointments manually, the improvements tested in this project are for the internal aspects of therapy evaluations and appointments.

The first improvement proposed having a separate dedicated set of workers specifically for evaluations. Multiple new evaluation appointments arrive a day, and this would help patients be seen in a timely manner. This change did not make a huge impact since it created a trade-off scenario where if more evaluations were seen, less follow-ups were seen. This improvement did increase the overall throughput of patients in the system. The cycle time (total time until the patient can leave) increased with statistical significance.

Two Sample t-Test Using Last Appointment Time vs Current State

<table>
<thead>
<tr>
<th>Appointment Type</th>
<th>PT</th>
<th>OT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average</td>
<td>220.56</td>
<td>220.56</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>311.82</td>
<td>311.82</td>
</tr>
</tbody>
</table>

The second improvement used a weighted system to prioritize the patients who haven’t been seen in a long time since the last appointment. This improvement found statistical significance. Similarly, there was a trade-off between increasing/decreasing evaluations and follow-up appointments. This improvement shows the cycle time decreased and patients left the hospital faster (shown above).

Recommendaions

The creation of an Access Database was created to aid in the manual evaluations or appointments. It may help to automate the manual, non-value-added process which covers an entire day shift of appointments. By adding more staff therapists, the hospital will increase the number of therapy orders completed. Since the hospital is using evaluations as a priority, there needs to be a way to improve the system in a way that the employees can work with. Another recommendation would be to explore the capabilities of Epic to attempt and find an automated scheduling tool to pull straight from the hospitals records to the inpatients care.

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