

# Maximizing Therapy Appointments by Improving a Hospital Scheduling Process

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**Abstract**—A hospital in the Northern Illinois region was 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 by improving the scheduling techniques. This project resulted in small, proposed improvements as well as a scheduling tool deliverable that the hospital will be able to use to cut down on scheduling time.

**Keywords**- physical therapy, occupational therapy, data analysis, simulation, improvements, utilization, scheduling

## I. INTRODUCTION

In the hospital environment, patients come for a service that initiates the need from a doctor for post care treatment. This project focused on inpatient physical and occupational therapy. A doctor initiated an order for a patient in their electronic system for the corresponding therapy. There was only a manual scheduling process that is creating a backlog of patients that are not being seen in a timely manner. A patient stay for inpatient therapy care can include an evaluation appointment where the therapist determined whether the patient needed follow-up appointment(s) before being discharged. At any appointment, it was possible that patients missed appointments or were not ready for the therapy. When scheduling patients, evaluations were a priority over follow-up appointments.

## II. PROBLEM STATEMENT

This hospital is experiencing issues with patients having long stays due to staff members abusing the priorities of evaluations and labeling follow-up appointments incorrectly to push patients through the system. Since the scheduler is to create the morning schedule based off of what patients need to be seen first, there is becoming a backlog of patients since the scheduling employee is only allotted one hour for scheduling and can only plan up until lunch of the same day. This is causing a lot of patients to wait in the system for longer than necessary since the scheduling process is so inefficient.

## III. OBJECTIVES

The objectives of this project include:

- Created a current state simulation that mimics the current process at the hospital.

- Developed and analyzed improvement scenarios
- Created a scheduling tool to assist the manual process

## IV. CURRENT STATE PROCESS

At the current time, the hospital's patients went through a similar process no matter if the appointment type is Physical Therapy (PT) or Occupational Therapy (OT). Figure 1 shows that after the patients see the doctor, the doctor initiated the order for therapy. Once the order was created, each patient had an evaluation with a therapist that then determined the number of follow-ups, if needed, the patient had to attend before being discharged and end the order.

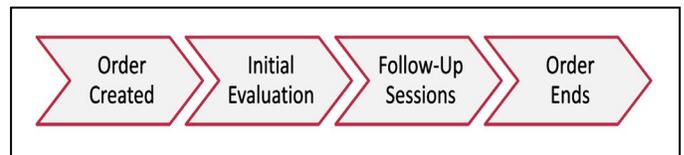


Figure 1. General Patient Process

Each order corresponds to one patient. A patient always had an evaluation appointment but the number of follow-ups varied based on the type of care needed.

## V. HOSPITALS DATA ANALYSIS

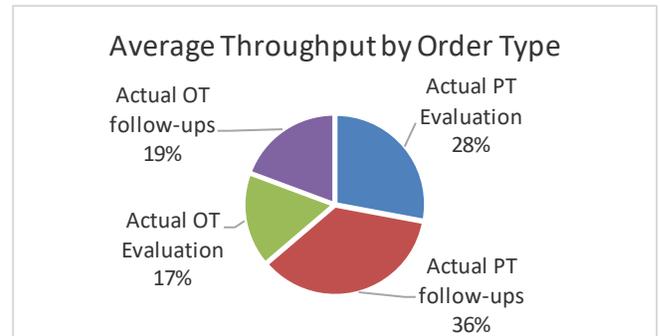


Figure 2. Average Throughput by Order Type

The hospital supplied the team with one year worth of data of PT and OT order records that included the order creation date and time, the order end date and time, the type of appointment, if the patient had an evaluation, and how many follow-ups were needed. One month worth of data contained a break-down of appointment types as well as evaluation and follow-ups statistics that allowed the team to create an accurate simulation of the process. Figure 2 shows the

breakdown analysis from the empirical data of average order types for one month. From the given data, the team found trends and calculated the average time between order creations (interarrival times), and average time a patient spends in the system. This information was required for the creation of a simulation of the process (See figure 3) to help analyze the current state and improvements.

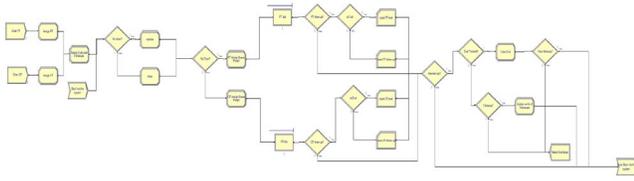


Figure 3. Overview of Simulation

## VI. FUTURE IMPROVEMENT PROPOSALS

The team created and implemented two changes into the current state simulation that were meant to improve the patient’s experience. The first improvement proposed having a dedicated set of workers specifically for evaluations. Since the hospital received multiple new evaluation appointments a day, this could help make sure patients are seen in a timely manner. The second improvement investigated the time in-between patients' appointments to help patients get seen sooner. This improvement used a weighted priority rule that put the patients who haven’t been seen in a long time in a higher queue position. This improvement decreased the cycle time and patients were able to leave sooner.

## VII. RESULTS

The first improvement was tested against the current state simulation to see how this affected the hospital’s process. 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, however there was insufficient statistical evidence this improvement would be warranted to adoption into the current scheduling process.

The second improvement saw a similar trade-off between increasing/decreasing evaluations at the expense of follow-up appointments. This improvement allows the cycle time to decrease and have patients leave the system faster. Although it does not increase throughput, it allows the team to see that the simulation can be used to test possible ideas before making drastic changes in real life where the company could lose time or money to see that the changes did not help.

## VIII. ECONOMIC ANALYSIS

An understanding that was established before beginning this project is that the hospital is currently understaffed.

Since a simulation was created, it allowed the team show the possible outcomes of hiring more individuals. The team was able to run the possibilities of adding more staffed therapists to see how much profit will be made. The state average of PT appointments was \$187.50 and OT appointments was \$225. The team assumed the staff members earned an annual pay of \$80,000 for PTs and \$52,000 for OTs. Table 1 shows a breakdown of the profit earned by adding additional PT Staff therapists which also resulted in additional patients being seen. Table 2 shows the same analysis for OTs.

TABLE 1: POTENTIAL PROFIT FOR INCREASING NUMBER OF PT

PT Therapist	10	11	12	13	14
PT Appointments Seen	3078	3382	3679	3996	4320
Monetary Value	\$ 577,106	\$ 634,041	\$ 689,803	\$ 749,222	\$ 810,000
Average PT cost	\$ 66,667	\$ 73,333	\$ 80,000	\$ 86,667	\$ 93,333
Profit	\$ 510,440	\$ 560,707	\$ 609,803	\$ 662,555	\$ 716,667

TABLE 2: POTENTIAL PROFIT FOR INCREASING NUMBER OF OT

OT Therapists	6	7	8	9	10
OT Appointments Seen	1850	2152	2456	2769	3079
Monetary Value	\$ 416,171	\$ 484,155	\$ 552,679	\$ 622,958	\$ 692,865
Average OT Cost	\$ 26,000	\$ 30,333	\$ 34,667	\$ 39,000	\$ 43,333
Profit	\$ 390,171	\$ 453,822	\$ 518,012	\$ 583,958	\$ 649,532

Using the proposed scheduling tool, or Access Database, the individual in charge of scheduling will be able to cut the time spent by 50%. By estimating the hourly wage of a nurse tech at \$20 an hour, scheduling for 1 hour a day, we estimate a yearly savings of \$3,360 if the scheduler is used.

## IX. CONCLUSION

The Access Database was created to aid in the manual evaluations or appointments. The Access database scheduling tool may help to automate a manual, non-value-added process. 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.

## ACKNOWLEDGMENT

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