Predictive Analysis of Infusion Center Scheduling, Staffing and Resource Utilization to Improve Patient Flow

### Emory Healthcare's Infusion Center

For the Infusion Center, issues with how resources were being utilized, schedule strategy, and a short staff led to long waiting times during busy days and peak hours. According to patients, spending more than 30-35 minutes in the waiting room was undesirable.

On top of that, their strategic plan forecasts a 9-10% increase in patient volume per year for the next three years. With such a complex and variable environment, they knew a simulation analysis would be the best way to find an optimal solution.

- Model the present state of patient and resource flow to identify and analyze system bottlenecks and performance metrics including lobby wait time and chair utilization to ultimately improve overall patient satisfaction.
- Obtain results from simulating operational scenarios including scheduling, staffing, and CPOE (computerized physician order entry), plus scenarios with estimated patient volumes over the next 3 years.
- Make operational recommendations to reduce patient waiting times and increase operational efficiency.

The first two recommendations implemented resulted in a 4% decrease in chair time and a 23.7% reduction of wait time in the lobby. They were as follows:

- Extend normal business hours from partial weekend hours (Sat-Sun 8am-2pm) to full weekend hours (Sat-Sun 7am-7:30pm).
- Run three bays on the weekend instead of two as initially planned.

Patients prefer weekend appointments, so expanding the weekend schedule not only helped reduce the stress on the system during the week, but also increased patient satisfaction.

- There are also plans to implement a re-organized schedule which would start the longer infusion appointments in the morning, and the 1, 2 and 3 hour appointments in the afternoon. Simulation results showed that chair times could be reduced by up to 13.7% and patient wait times by 35.76% from the current state.

- Reducing patient wait times was the primary objective of the project. The simulation helped identify solutions that would reduce wait times while, at the same time, improving patient satisfaction scores.

“Administration, the Nurse Manager and Front End Supervisor all agreed that the model was a very fair representation of how the center actually operated.”

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**Scheduling Scenarios - Chair Time per Patient (mins)**

| Scheduling Scenario | 1 and 2 Hour Infusion | 3 Hour Infusion | 4 Hour Infusion | 5 Hour Infusion | 6 Hour Infusion | 7 Hour Infusion | Average
|---------------------|-----------------------|----------------|----------------|----------------|----------------|----------------|--------
| 1 and 2 Hour Infusion | 18.75 | 34.45 | 26.6 | 18.81 | 24.95 | 17.14 | 18.58 | 18.21 | 16.38
| 3 Hour Infusion | 21.33 | 33.67 | 27.45 | 10.97 | 36.05 | 24.6 | 19.17 | 35.09 | 27.13
| 4 Hour Infusion | 15.19 | 30.55 | 22.61 | 33.89 | 26.3 | 15.26 | 27.28 | 21.32
| 5 Hour Infusion | 18.9 | 46.5 | 36.1 | 19.73 | 37.7 | 23.05 | 18.95 | 24.87 | 18.71
| 6 Hour Infusion | 8.38 | 26.24 | 19.87 | 7.9 | 17.95 | 15.0 | 4.86 | 12.88 | 8.06
| 7 Hour Infusion | 8.07 | 4.25 | 12.86 | 5.92 | 3.17 | 12.08 | 7.24 | 12.81 | 10.23
| Average (mins) | 52.62 | 29.42 | 34.28 |

**Scheduling Scenarios - Patient Wait Time in Lobby (mins)**

| Scheduling Scenario | 1 and 2 Hour Infusion | 3 Hour Infusion | 4 Hour Infusion | 5 Hour Infusion | 6 Hour Infusion | 7 Hour Infusion | Average
|---------------------|-----------------------|----------------|----------------|----------------|----------------|----------------|--------
| 1 and 2 Hour Infusion | 10.75 | 34.45 | 26.6 | 18.81 | 24.95 | 17.14 | 18.58 | 18.21 | 16.38
| 3 Hour Infusion | 21.33 | 33.67 | 27.45 | 10.97 | 36.05 | 24.6 | 19.17 | 35.09 | 27.13
| 4 Hour Infusion | 15.19 | 30.55 | 22.61 | 33.89 | 26.3 | 15.26 | 27.28 | 21.32
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Using MedModel, the Emory Clinic Operations Support Department built a simulation model and conducted a predictive analysis of their patient flow. Several scenarios were run to evaluate different aspects of the center including scheduling, staffing, CPOE (Computerized Physician Order Entry) and the projected patient volume increase. All of these scenarios affect wait time and thus patient satisfaction.

**Scheduling Scenarios Analyzed:**
- **Baseline – Present State** (Mon-Fri, 7 am-7:30 pm, Sat-Sun, 8 am-2 pm)
- **Saturday and Sunday Full Business Day** (Mon-Fri, 7 am-7:30 p.m)
- **Saturday & Sunday Full Business Day + Smoothed Arrivals:** 1, 2, 3 hour infusion arrivals shifted to later in the day.

**Scheduling Scenario Findings:**
- Shifting patient volume by extending the business hours of Saturday and Sunday to 12 hours (7:30 am to 7:30 pm) reduces average chair time by 4% and average wait time in the lobby by 23.7%.
- Adjusting schedules of 1, 2, & 3 hour infusions to the afternoon session each work day in addition to the full weekend hours reduced chair time and wait times even further to 13.7% and 35.76% respectively.

**Staffing Scenarios Analyzed:**
- **Baseline – Present State** (All bays open and fully staffed)
- **7 Bays (2RN)** – All Bays open with 1 RN off-shift (Mon-Fri)
- **6 Bays** – 1 bay closed due to absence of 3 RN (Mon-Fri)

**Staffing Scenario Findings:**
- Absence of a single RN: 9.5% increase in patient wait times in lobby
- Full bay is closed: 113.7% increase in patient wait times.

**CPOE Scenarios Analyzed:**
- **Baseline – Present State** (Current pharmacy order processing times)
- **CPOE – Reduced Order Processing Time** (estimated 15 minute decrease)

**CPOE Scenario Findings:**
- CPOE has the potential to significantly reduce pharmacy processing times by reducing order errors and eliminating the need to manually transport orders to the pharmacy. CPOE can potentially result in reductions of 35% in pharmacy turnaround time, 7.6% in chair time and 20% in lobby wait time.

**Future State Scenario Analyzed:**
- 32% increase in patient volume over the next 3 years

**Future State Scenario Findings:**
- To accommodate the increased volume while maintaining current chair times, 2 additional RNs will be needed from Mon-Fri.
- All 7 bays will need to be fully operational on Sat-Sun with 12 additional RNs and 4 full time MAs.

The simulation results also revealed that the 1 hour buffer time built into scheduled visit durations was not enough to account for the delays caused by lab equipment downtime, pre-medication and initial assessments.

Based on the recommendations made, the Infusion Center Leadership is planning to lead a collaborative effort which will engage infusion center, lab and most importantly, the physicians, to come together and work toward synchronizing their schedules in order to increase operational efficiency while reducing patient wait times and chair times.