CENTER FOR HEALTHCARE ENGINEERING & PATIENT SAFETY

Improving Patient Access by Simulating Supply and Demand to Determine Scheduling Capabilities

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Introduction

Ensuring adequate access to care is a pressing issues in healthcare. At Michigan Medicine, increasing demand for ambulatory care has resulted in average lead times of 6 months, which can result in adverse effects for patients who need urgent specialty care. Consequently, Michigan Medicine has defined an internal goal of ensuring that 50% of new patients seeking ambulatory care are seen within 2 weeks of requesting an appointment.

This project aims to provide insights to help achieve this internal goal via a modular discrete event simulation that gives users the ability to A) test changes in supply (structure of a provider's schedule) to B) accommodate changes in demand (number of patients with varying appointment requests) and C) evaluate these decisions by analyzing resulting metrics (patient delay times, provider utilization, and patient throughput).

Table Structure

Event Table
All requests patients make (schedule or cancel)

A. Events result in tasks
B. An appointment is a mapping between a scheduling task and a slot

A

Task Table
All actionable items stemming from an event

Slot Table
The set of schedulable time intervals

B

Appointment Table
A compiled list of all scheduled appointments

Acknowledgements

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Algorithm Overview

1. Initialize slot schedule and empty tables
2. Parameterize patient event probabilities
3. Generate events and process tasks
4. Analyze results, output metrics and graphs

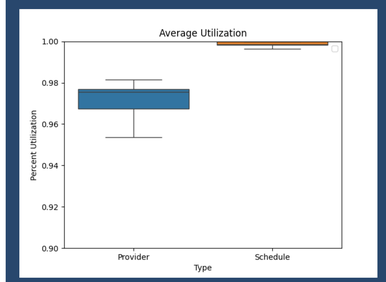
1. Using a user-generated or historical slot template, build a slot schedule that spans the length of the scheduling horizon
1. Taking in historic appointment and referral data, parameterize arrival, cancellation, no-show,, and referral rates by each visit type.
1. Each period, generate new patient arrivals and events using the calculated parameters. Process scheduling tasks (new patients, cancellations, no-shows, and backlogged referrals) with a predetermined slot availability method (unconstrained availability or blocked scheduling).
1. Calculate delay and utilization metrics, and output result tables and graphs.

Insights on Department Capacity

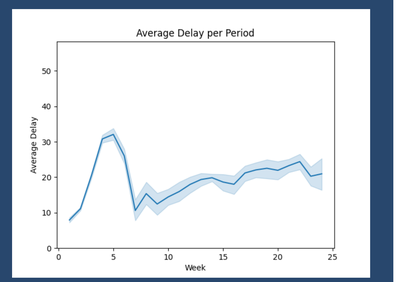
$$Delay\ Time = Appointment\ Period\ - Target\ Period$$

$$Schedule\ Utilization = \left(\frac{Slots\ Filled}{Total\ Slots}\right) x\ 100$$

Metrics with Blocked Slots

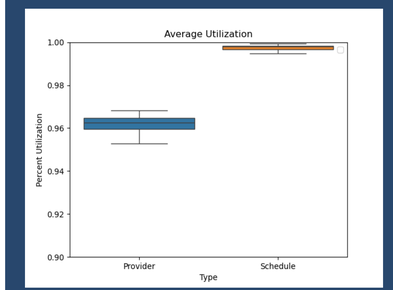


A

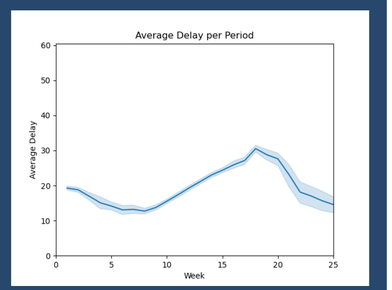


B

Metrics with Unconstrained Slots



C



D

The graphs above display utilization and delay for blocked (A and B) and unconstrained (C and D) schedule models. Blocked policy only allows certain visit types to be scheduled into certain compatible slots. Unconstrained allow any visit type in any slot. These results indicate that the flexibility provided by the unconstrained model decreases delay times seen in a blocked model, suggesting there is adequate slot supply in the current state to meet demand, but it may be allocated inefficiently.

Next Steps

More Providers

At Present
- We are currently working with Michigan Medicine Urology and Neurology.

Future
- We would like to expand to other departments to provide more value and make the simulation more robust.

New Features

At Present
- We are currently handling one provider.
- We need special permissions to access Epic data, then process data via .csv files in the simulation.

Future
- We would like to extend this to the department level.
- We will work on getting data directly from Epic MiChart.

Optimization Algorithms

At Present
- The simulation requires users to manually input changes in demand or supply they want to test.

Future
- We will research and implement industry standard ways of optimizing supply to accommodate demand fluctuations.