Simulating Scheduling to Improve Healthcare Access

Nicholas Zacharek[1]; Tarek Bsat[1]; Michelle Chen[1]; Simran Malik[1]; Hannah Heberle-Rose[1]; Pushpendra Singh[1]; Adam VanDeusen[1]; Jacob Kurlander[2], MD; Samir Saini[2], MD; Megan Adams[2], MD; Amy Cohn[1], PhD
[1]Industrial and Operations Engineering, University of Michigan, Ann Arbor, Michigan
[2]Internal Medicine, University of Michigan, Ann Arbor, Michigan

Introduction

Across the United States, people face barriers to accessing healthcare, including specialty care. Specialty care refers to care provided by physicians trained in a specific branch of medicine outside the scope of primary care. For many patients, access to specialty care is limited due to geographic, economic, and logistical constraints.

Telehealth, care provided by a physician via Internet-based platforms, has the potential to improve access to care for many patients. This project employs simulation methods to evaluate how different scheduling policies can affect access to care for patients with gastroesophageal reflux disease (GERD) while considering patient preference for appointment modality.

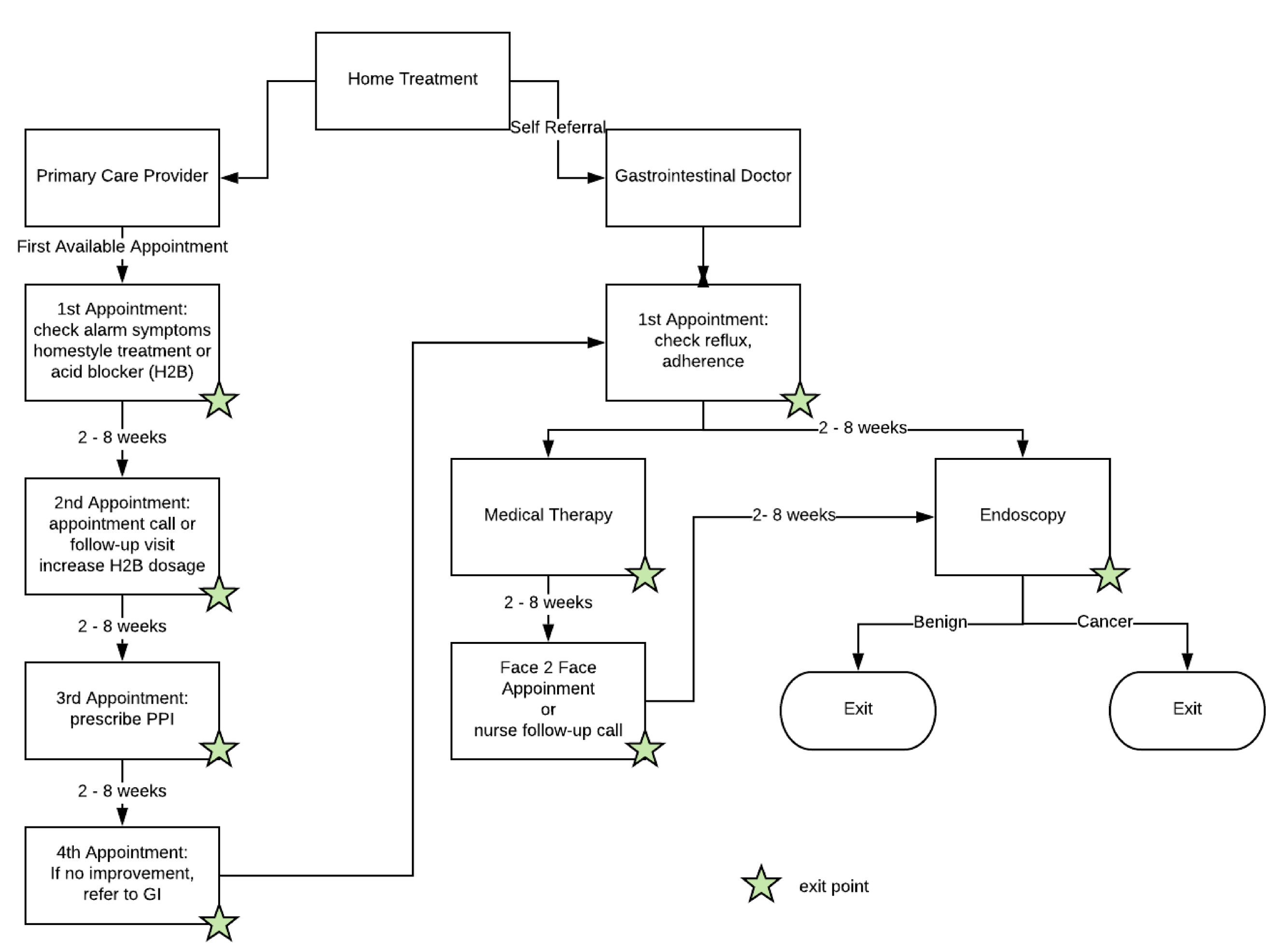

Figure 1: GERD patient flowchart

Objectives

1. To guide clinical decision-makers in innovative strategies to improve patient access to care
2. To better understand how simulation methods can represent scheduling and other healthcare administrative policies
3. To demonstrate how telehealth and patient preferences about telehealth impact access to specialty care.

Methods

Simulation is an industrial engineering tool used to help build scenarios and understand outcomes while considering uncertainty in systems. We use a set of inputs, each with some randomness about their values, and a system of appointments for patients to "flow" through during a simulation. We partnered with gastroenterologists to understand these simulation components, as well as to determine different policies for patient scheduling (below), based on patient preferences for different appointment types.

- "In-Range" Policies
  - A. First available – any type
  - B. First available – preferred only
  - C. First preferred available. If no preferred, first available of any type
- "Out-of-range" policies
  1. First available – any type
  2. First available - preferred

We run our simulation in C++, replicating scenarios several hundred times, each time with varied inputs. We calculate metrics of interest, including values like time to an appointment and how often their preferences for appointment types are met. We also conducted sensitivity analyses to determine how different inputs impact our outcomes.

Results and Discussion

Baseline metrics of our simulation are shown in Table 1 (shown here for policy A1).

Metric	Mean Result
Patients completing care	365.8
Benign/healthy endoscopies	156.1
Malignant endoscopies	17.3
Overall provider utilization	0.91
Face-to-face utilization	0.95
Telehealth utilization	0.88
Lead time	5.0 weeks
Modality preferences met	50.5%
Total cost	$172,866

Table 1: Baseline results (Scheduling Policy A1)

Our sensitivity analyses indicated an array of results that inform us of how inputs impact our outcomes of interest. A sample of those analyses are included in Figure 2, considering how inputs impact the percentage of patients who are scheduled for their "preferred" type of appointment, separated by the different scheduling policies.

Figure 2: This table represents how different inputs impact the percentage of patient preferences being met under each scheduling policy.

Conclusions

This work indicates how simulation can be used to better understand access to specialty care and how telehealth can play a role in improving access to such care. As our results indicate, the policies we use to schedule patients for specialty care appointments, both telehealth and face-to-face, can impact access. Such policies can be leveraged to help meet patients' preferences about such appointment types.

Next steps for this project include:
- Updating patient flow to allow more flexibility between appointments
- Allowing for patient no-shows and cancellations
- Expanding patient attributes

Acknowledgements

The project team greatly appreciates financial support from the University of Michigan Institute for Healthcare Policy and Innovation, the Michigan Program on Value Enhancement, and the Seth Bonder Foundation.

We are also grateful for the project support provided by the University of Michigan Center for Healthcare Engineering and Patient Safety (CHEPS).

[SURE ###]