Simulation Tools to Improve Patient Access and Flow in Endoscopy

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CHEPS

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Rx

A prescription to address system complexity in healthcare

INNOVATING HEALTHCARE DELIVERY

FOSTERING LEARNING

BUILDING COMMUNITY

POSITIVE IMPACT THROUGH...
Research
Education
Implementation
Outreach
Dissemination

OVERVIEW

- We present a simulation model for the schedule creation and daily operations of an outpatient endoscopy clinic

- By simulating both scheduling and operations, we can include more sources of variability and better estimate how a clinic actually operates

- This combination also allows us to capture a variety of metrics associated with both scheduling and operations

- The goal for today's talk is not to give specific recommendations but show how the integration of these stages is important

OUTLINE

- Project Motivation

- Simulation Details

- Sample Analyses

- Conclusions

MOTIVATION

Colonoscopy, a type of endoscopy, is important because…

Colorectal cancer (or CRC) is the second-leading cause of cancer death in the United States [1]

Colonoscopy may reduce CRC incidence by up to 40% and reduce mortality by up to 50% [2]

MOTIVATION

- Scheduling endoscopy patients is both important and challenging because

    - There is variability in patient demand for appointments, preferences, arrivals, no-shows, and procedure durations

    - Trade offs must be made between patient access, quality of care, resource utilization, and patient and provider satisfaction

LITERATURE REVIEW

Researchers generally focus on either scheduling or operations when building clinical simulation models – we're doing both.
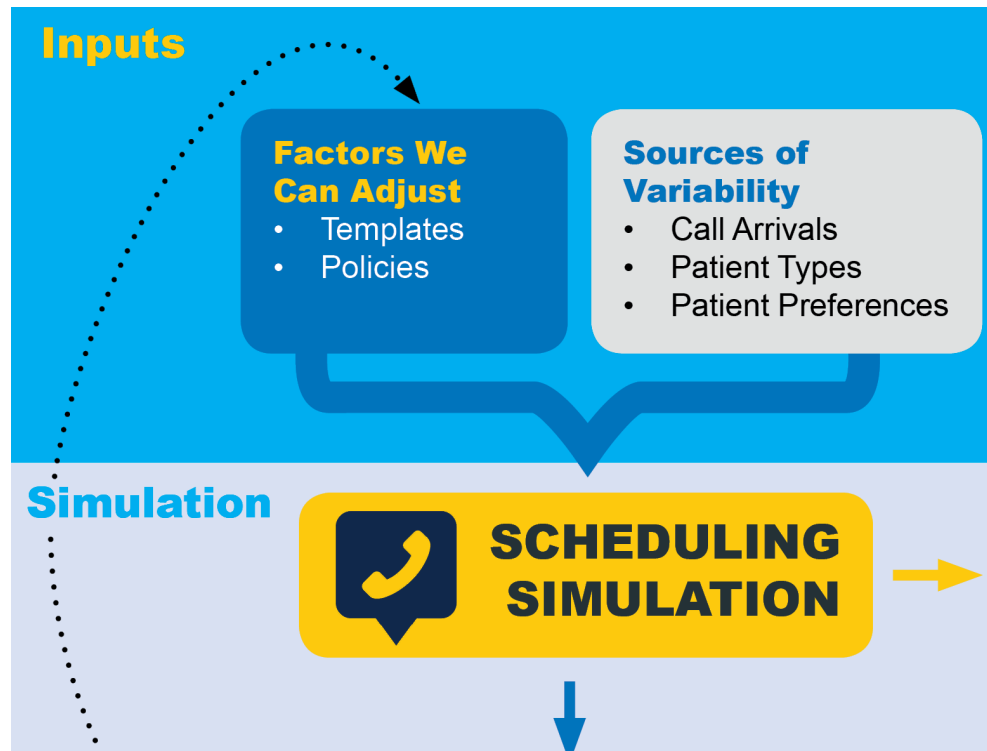
SCHEDULING:

- A stochastic overbooking model for outpatient clinical scheduling with no-shows (Muthuraman & Lawley, 2008)

OPERATIONS:

- Reducing Outpatient Waiting Time: A Simulation Modeling Approach (Aeenparast et al., 2013)

- Simulation modeling to optimize healthcare delivery in an outpatient clinic (Norouzzadeh et al., 2014)

FRAMEWORK

Inputs

Factors We Can Adjust
- Templates
- Policies

Sources of Variability
- Call Arrivals
- Patient Types
- Patient Preferences

Simulation

SCHEDULING SIMULATION

TEMPLATE

- Base of the schedule

- Defined by a set of dates

  - For each date:
    - Open and close time
    - Set of appointment slots
    - Set of candidate patient types for each appointment slot

	Monday	Tuesday	Wednesday	Thursday	Friday
7:00					
8:00					
9:00					
10:00					
11:00					
12:00					
13:00					
14:00					
15:00					
16:00					
17:00					
18:00					

VALUE	ABBREVIATION
Return Visit	RV
New Patient	NP
Procedure	Proc

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SCHEDULING POLICIES

- Rule for filling appointment slots

- Example Policies

  - First-Come- First-Serve (FCFS)

  - FCFS by Patient Type

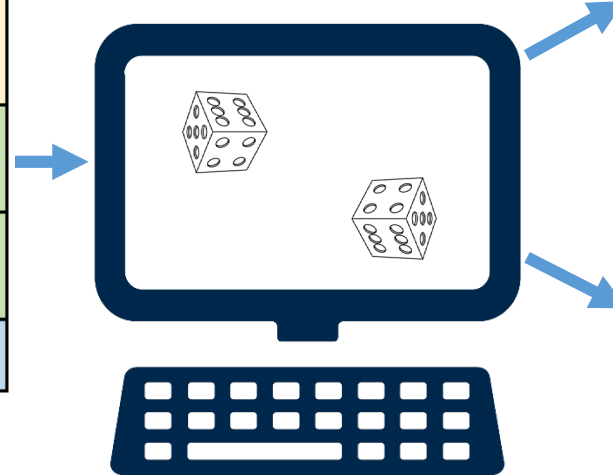 - FCFS by Type including preference

	Monday	Tuesday	Wednesday	Thursday	Friday
7:00					
8:00					
9:00					
10:00					
11:00					
12:00					
13:00					
14:00					
15:00					
16:00					
17:00					
18:00					

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SIMULATING SCHEDULE CONSTRUCTION

SIMULATING CLINIC OPERATIONS

Patient Arrives at Clinic – Variability in arrival

Procedure duration is generated – Variability in duration and prep

Patient Exits the Clinic
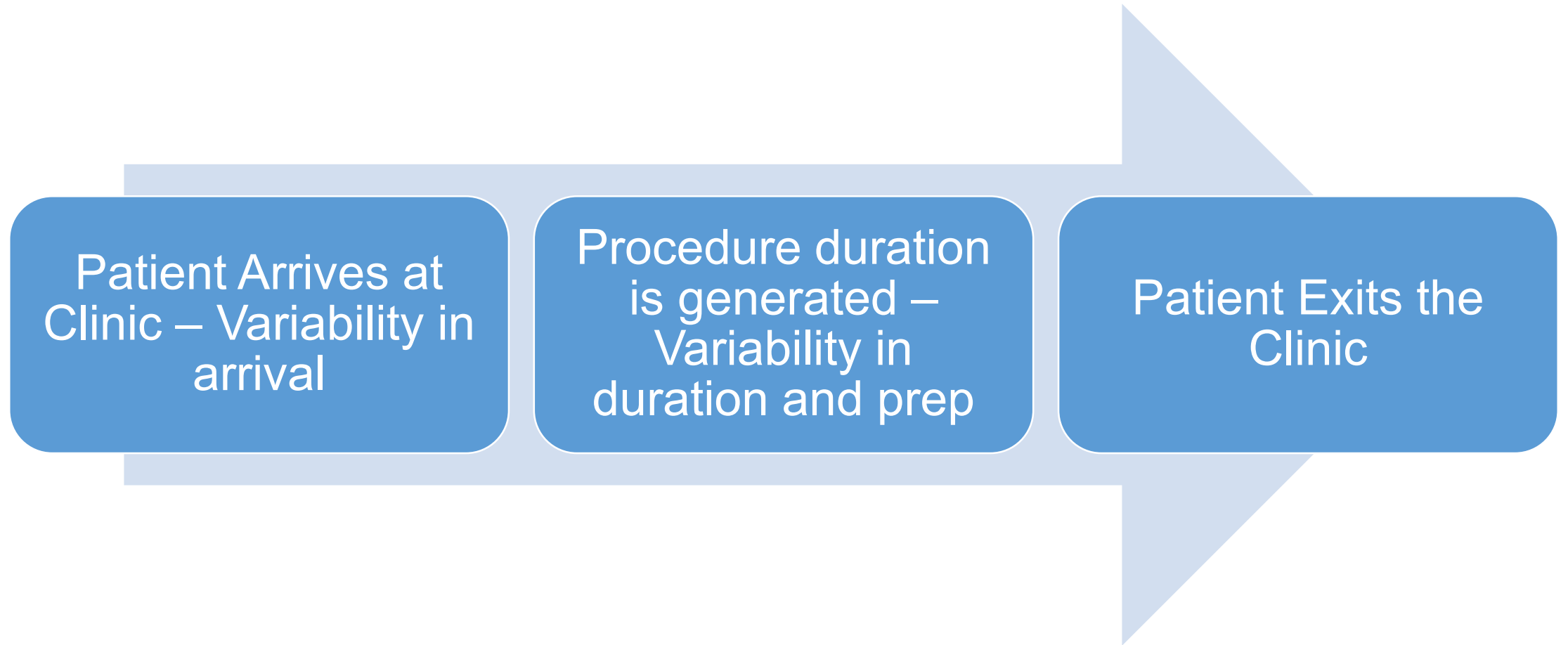
METRICS

# of Patients Scheduled/Unable to Schedule	**Average Lead Time**	**Patient Preferences**
Patient Wait Time	**Provider Idle Time**	**Provider Overtime**
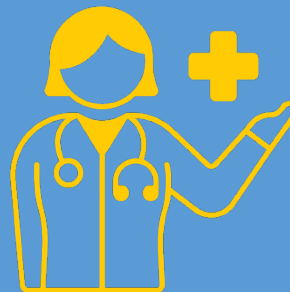
SAMPLE ANALYSES

SIMULATION DETAILS

Assumptions

- There is a single provider
- There are discrete groups of patient types

Parameters

- 1000 Replications
- 26 weeks (6 months)
- 2 patient types (simple and complex)
- Lag time of 5 days

SAMPLE SCHEDULING POLICIES

Case 1

Simple Template and Policy: All appointments 45 minutes; first-available-appointment scheduling

Case 2

Schedule by Patient Type: 4:1 ratio of 40 and 60 minute appointments; first-available-appointment-by-type

Case 3

Case 2 plus Patient Preferences: Add in 25% likelihood for each morning/afternoon of patient unavailability

SCHEDULE TEMPLATES

Case 1
(Typical Clinic)
Template

Time of Day	Appointment
9:00	Appt Slot
9:30	
10:00	Appt Slot
10:30	Appt Slot
11:00	
11:30	Appt Slot
12:00	Appt Slot
12:30	
1:00	Appt Slot
1:30	Appt Slot
2:00	
2:30	Appt Slot
3:00	Appt Slot
3:30	
4:00	Appt Slot

Case 2 and 3
(New Policy)
Template

Time of Day	Appointment
9:00	Type A
9:30	Type A
10:00	
10:30	Type A
11:00	Type A
11:30	
12:00	Type B
12:30	
1:00	Type A
1:30	Type A
2:00	Type A
2:30	
3:00	Type A
3:30	Type B
4:00	

RESULTS – TYPICAL CLINIC VS. NEW POLICY

Change in Key Metrics from Case 1 (Typical Clinic) to Case 2 (New Policy)

Case	Average Patients Seen	Lead Time per Patient (Days)	Wait Time per Patient (Min)	Overtime per Day (Min)	Idle Time per Day (Min)
Case 1	1275	6.77	7.93	12.47	46.14
Case 2	1260	7.51	2.68	2.58	44.25
Change	**-15**	**+.74**	**-5.25**	**-9.89**	**-1.90**

RESULTS – NEW POLICY VS. NEW POLICY WITH PREFERENCE

Change in Key Metrics from Case 2 (New Policy) to Case 3 (New Policy with Preference)

Case	Average Patients Seen	Lead Time per Patient (Days)	Wait Time per Patient (Min)	Overtime per Day (Min)	Idle Time per Day (Min)
Case 1	1275	6.77	7.93	12.47	46.14
Case 2	1260	7.51	2.68	2.58	44.25
Case 3	1257	7.62	2.68	2.55	44.91
Change (2 v 3)	**-3**	**+0.11**	**0**	**-0.03**	**+0.66**

KEY POINTS FROM ANALYSES

Using by-type scheduling policy greatly reduces the wait time but also increases lead time

The template can have large effects on metrics when scheduling by-type

Adding in patient preferences doesn't have a significant impact on many of the metrics

CONCLUSIONS

- Our simulation of clinic scheduling and operations allows new policies to be tested robustly at low cost.

- We were able to test basic policies against new policies and analyze tradeoffs between important clinic metrics.

- Other clinics could use a similar tool to this to model their own operations and test them against new policies.
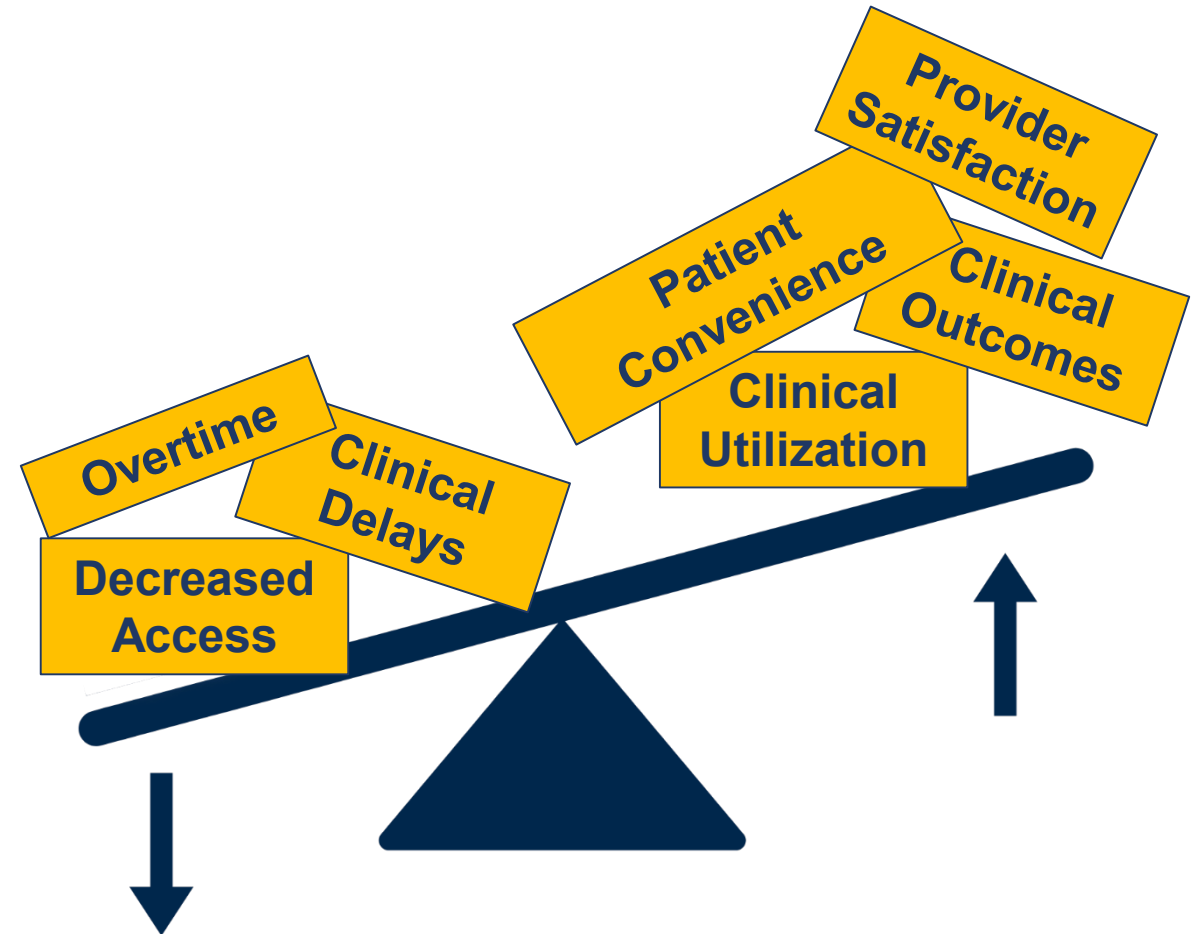
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QUESTIONS?

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