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Using Simulation to Evaluate Scheduling Policies for Specialty Care to Consider Patient Preferences

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CENTER FOR
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UNIVERSITY OF MICHIGAN

CHEPS

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Rx

A prescription to address system complexity in healthcare

INNOVATING HEALTHCARE DELIVERY

FOSTERING LEARNING

BUILDING COMMUNITY

POSITIVE IMPACT THROUGH...

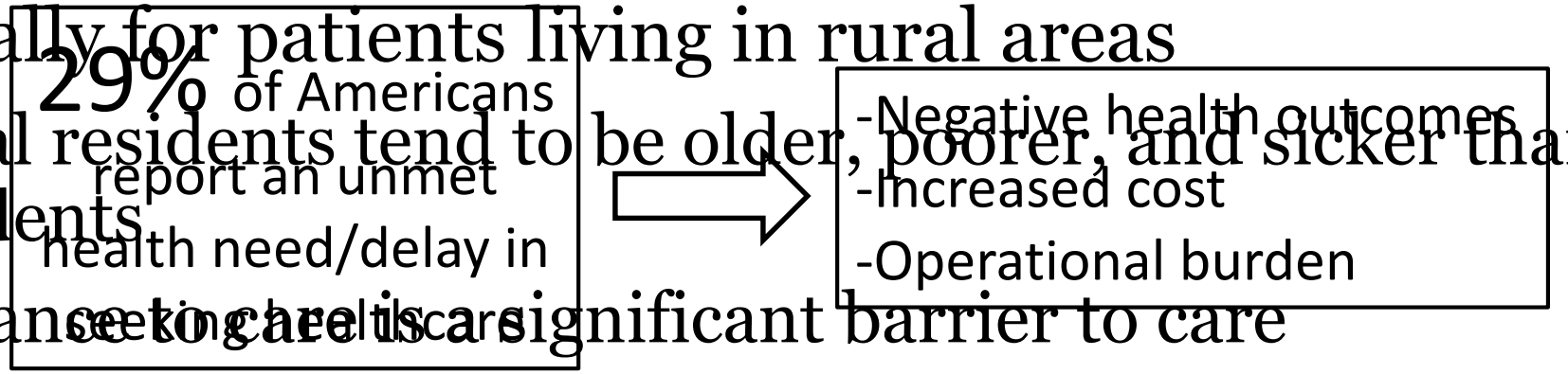
Research
Education
Implementation
Outreach
Dissemination

Central Question

How do we evaluate how scheduling policies impact access to care for rural patients with gastroesophageal reflux disease while also considering patient preference for appointment modality?

Background

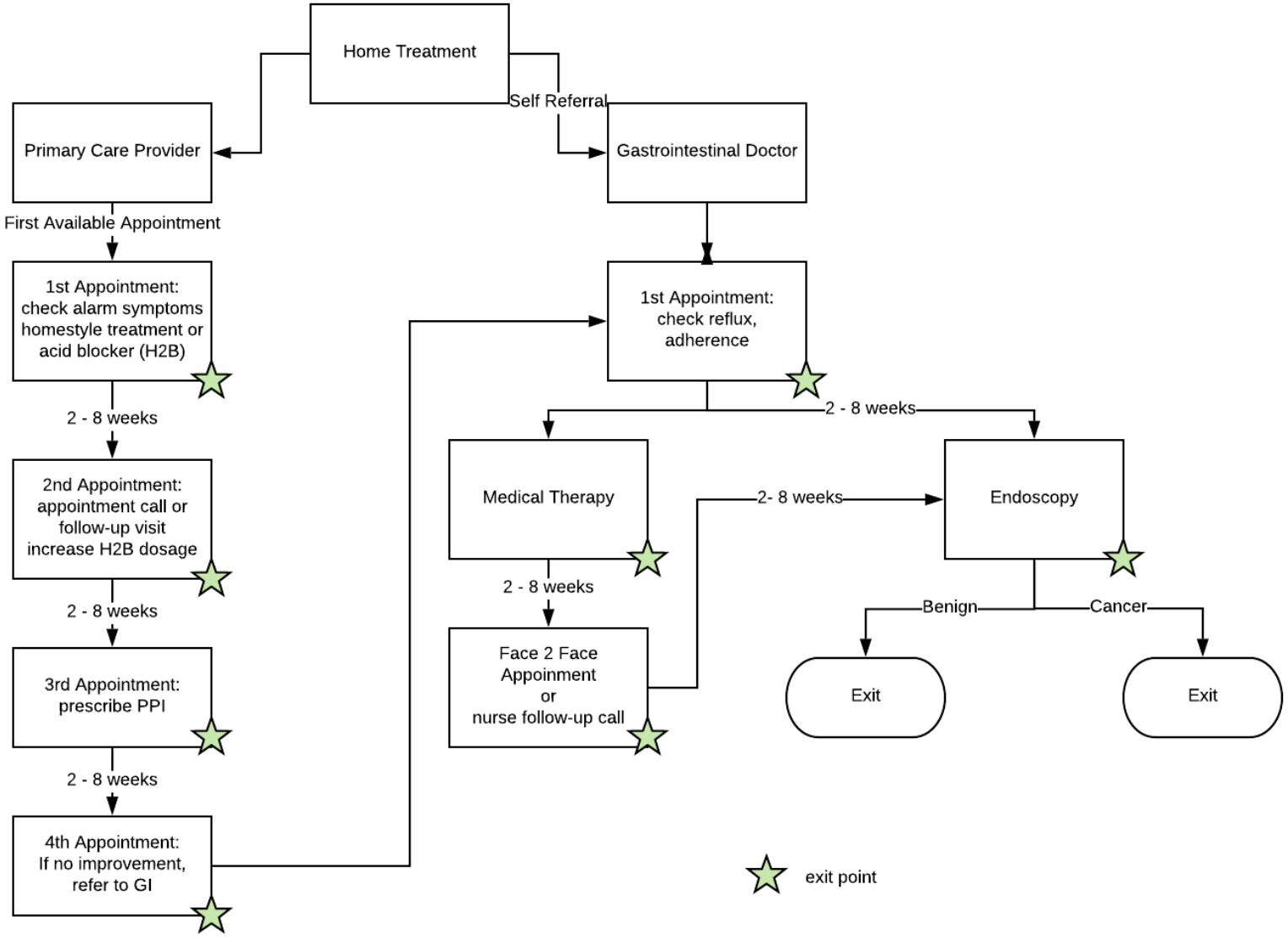
- Primary vs. specialty healthcare
  - Primary care providers: routine care, maintain health over time
  - Specialists: trained in a particular branch of medicine
- Timely access to care impacts outcomes
- Telehealth has the potential to improve access to care, especially for patients living in rural areas
  - Rural residents tend to be older, poorer, and sicker than urban residents
  - Distance to care is a significant barrier to care



Problem Focus

- Patients using VA Medical Center in Ann Arbor, MI
- Currently considering GERD patients
  - Gastroesophageal reflux disease
- Face-to-face versus telehealth
- Simulate patients flowing through our system
  - How do scheduling policies impact patients' ability to get the care they prefer?
  - What policies or system factors impact access?

GERD Patient Flow



Inputs: Providers and Diagnoses

- Providers
  - PCPs (2)
    - Capacity: 4 Telehealth, 3 Face-to-Face
  - GI (2)
    - Capacity: 4 Telehealth, 3 Face-to-Face
- Disease diagnoses
  - GERD
    - For those who get endoscopy, probability of benign/healthy diagnosis: 0.90

Inputs: Appointments

- Appointment Types
  - Face-to-Face
    - PCP cost: $100
    - GI cost: $200
  - Telehealth
    - PCP cost: $75
    - GI cost: $150
- Exit probability at each appointment: 0.16
- Endoscopy probability: 0.05

Inputs: Patients

- Patient Arrivals
  - PCP: 5/week
  - Self-Refer to GI: 7/week
- Patient location
  - Probability of "far" patient: 0.014
    - "Far" = more than 40 miles from clinic
- Patient preference
  - Prefer telehealth for "near" patients: 0.5
  - Prefer telehealth for "far" patients: 1.0

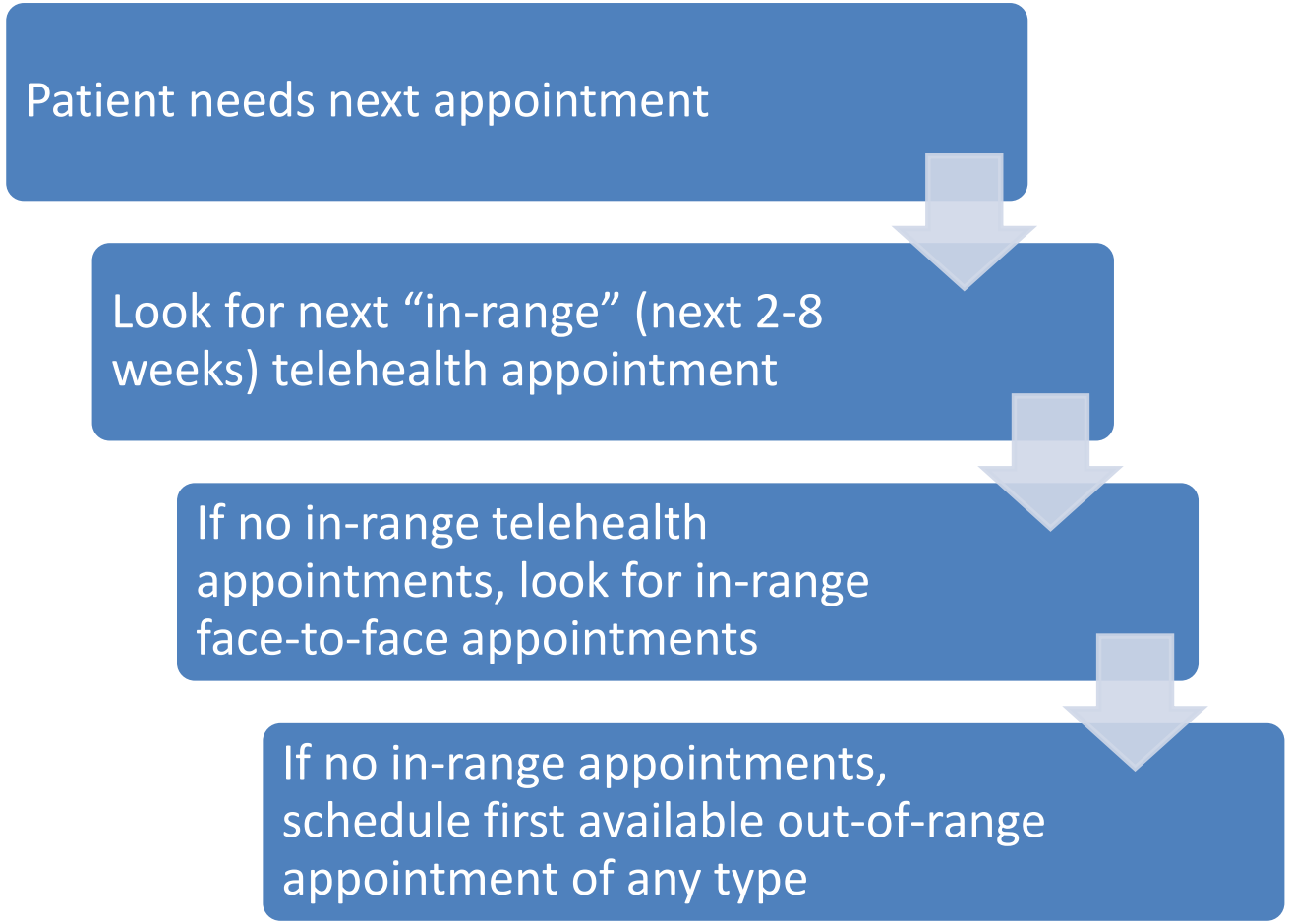
Scheduling Policies

- "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

Scheduling Policies

- "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

<u>Example: Policy C1, patient prefers telehealth appointments</u>



Simulation Methods

- Simulate in C++
  - Unit of time: weeks
  - Simulation length: 52 weeks
  - Replications: 500
- Sensitivity analyses to determine influential inputs

Metrics

- Total exits (patients “completing” care/leaving system for other reasons)
- Provider utilization
  - Overall, and stratified by face-to-face/telehealth and provider type
- Lead time
- Percentage of appointment preferences met
- Total cost
- Total benign/healthy endoscopy patient and total malignant patients

Sample Results

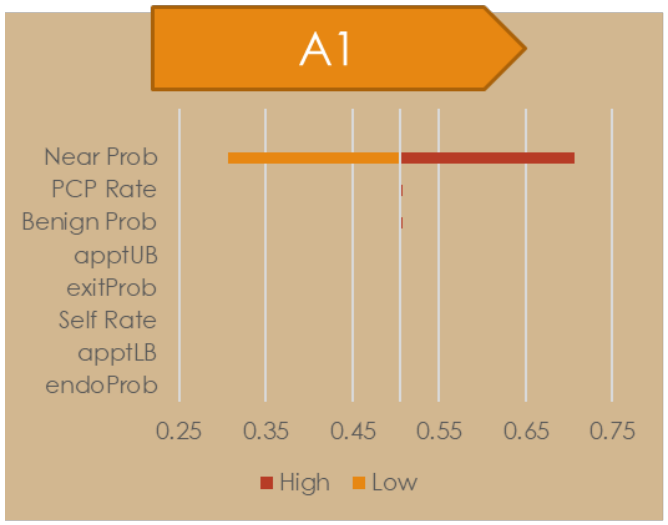
Metric	Mean Result
Patients completing care	365.8
Benign/healthy endoscopies	156.1
Malignant endoscopies	17.3
Overall provider utilization	0.91
Face-to-face utilization	0.95
Telehealth utilization	0.88
Lead time	5.0 weeks
Modality preferences met	50.5%
Total cost	$172,866

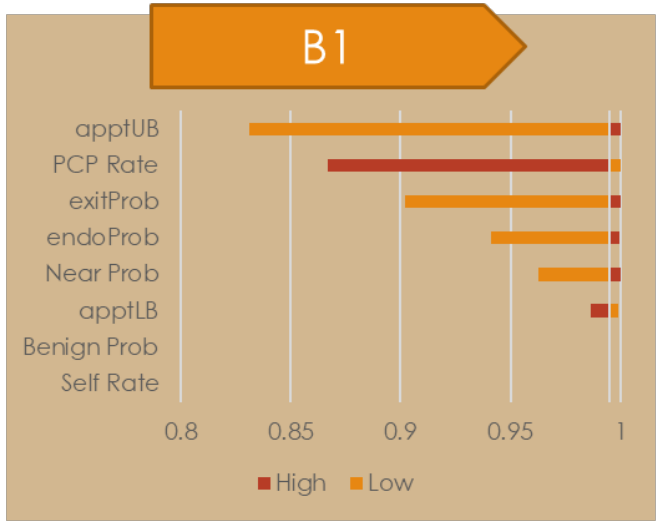
Baseline inputs, Policy A1

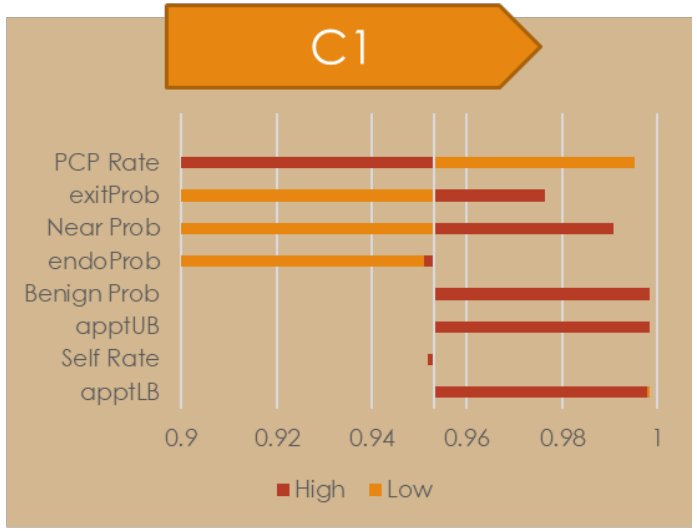
Sensitivity Analyses

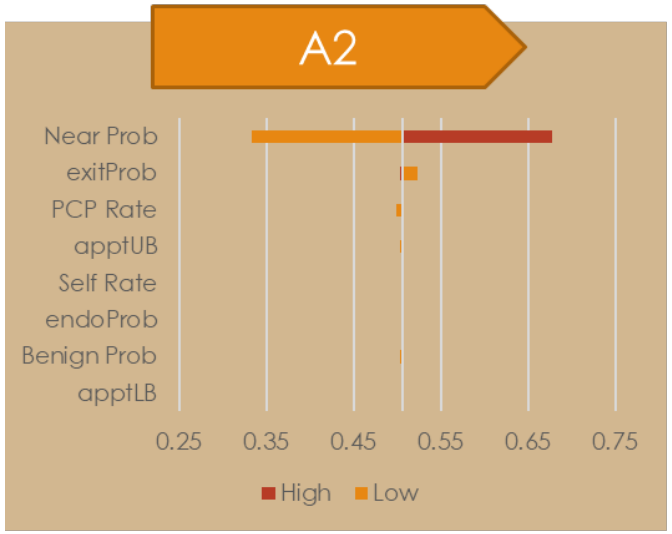
- Inputs changed (one at a time, ± 50%):
  - PCP_Rate (# of patients/week that arrive to PCP)
    - Example: baseline is 5 patients/week, check 3 and 8 patients/week
  - Self_Rate (# of patients/week that arrive via self-referral)
  - ApptLB/UB(lower bound/upper bound of appointment range)
  - ExitProb (probability a patient will complete care at each appointment)
  - NearProb (probability that a patient will live within 40 miles)
  - BenignProb (probability that patient will receive a benign result from endoscopy)

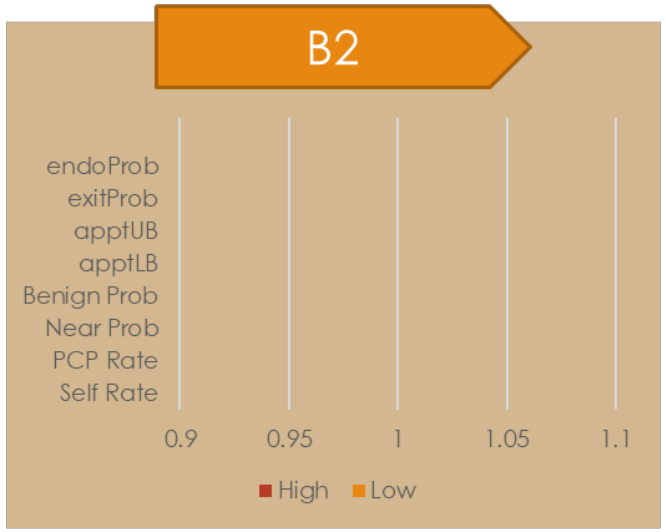
% Modality Preference Met

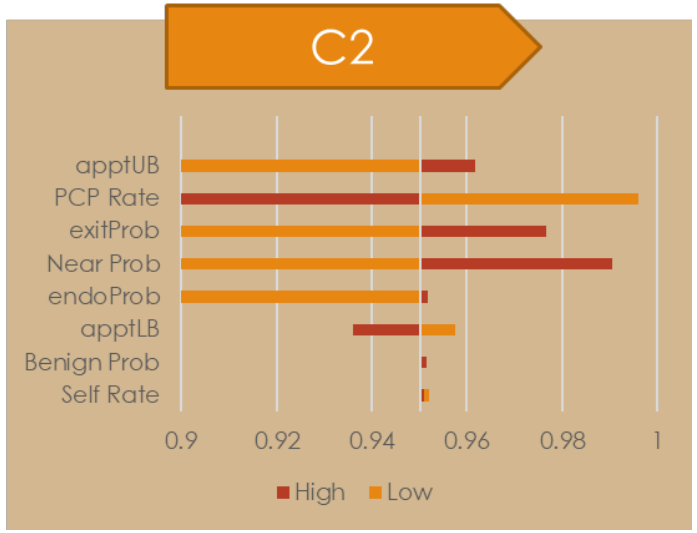








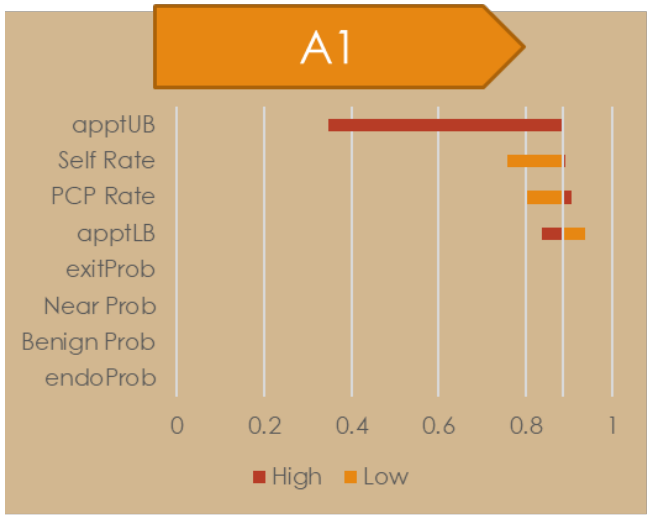


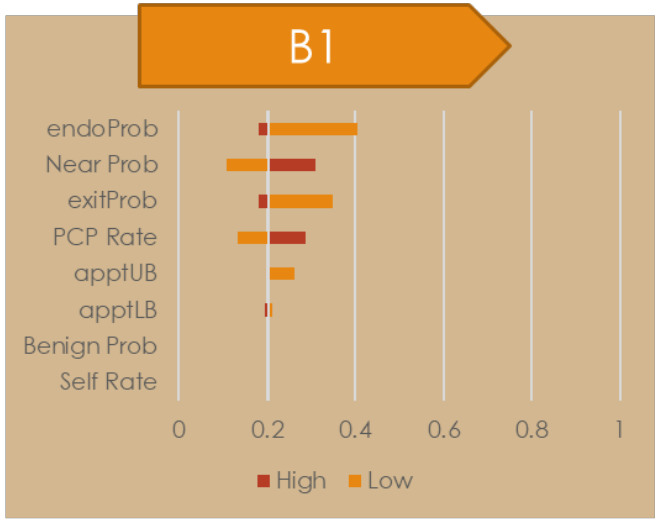


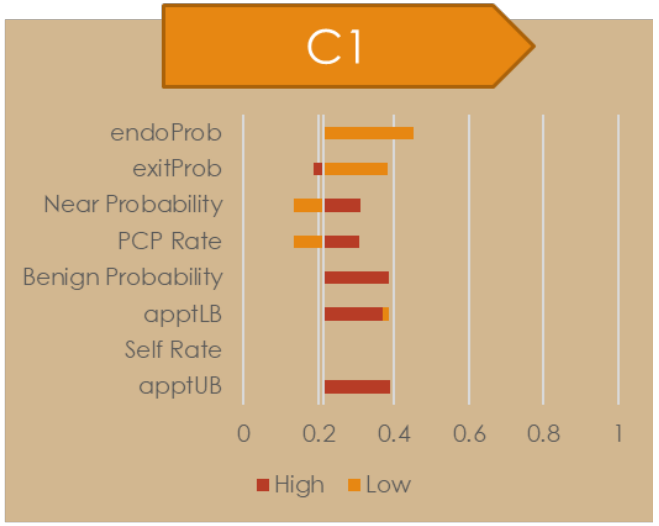
Considerations: % Preference Met

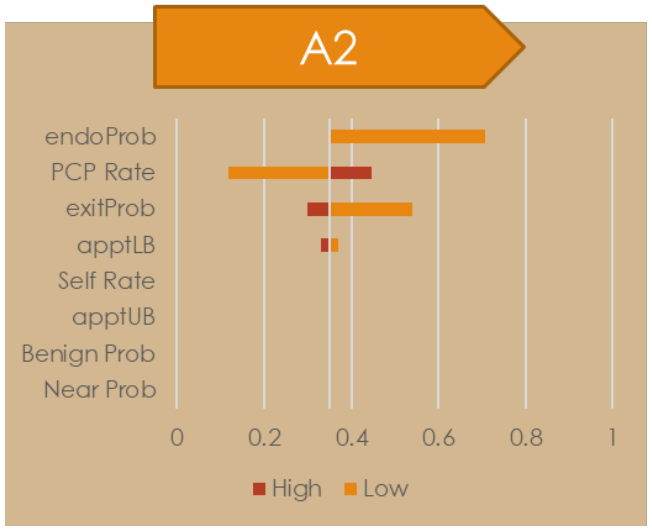
- Only Near Probability significantly influenced In-Range Policy A
- Appointment time range upper-bound influenced policies B1 and C2, but not any other scheduling policies
- B2 and B1 had the highest preference on average (~0.98-1), while A1 had the lowest preference (~0.5)

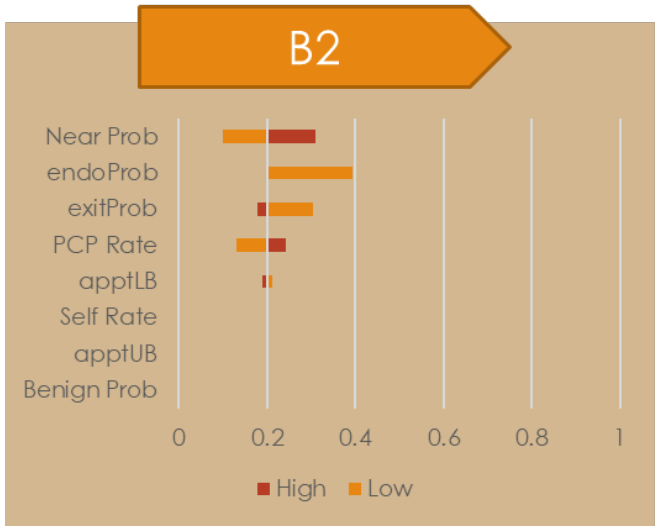
Telehealth Utilization

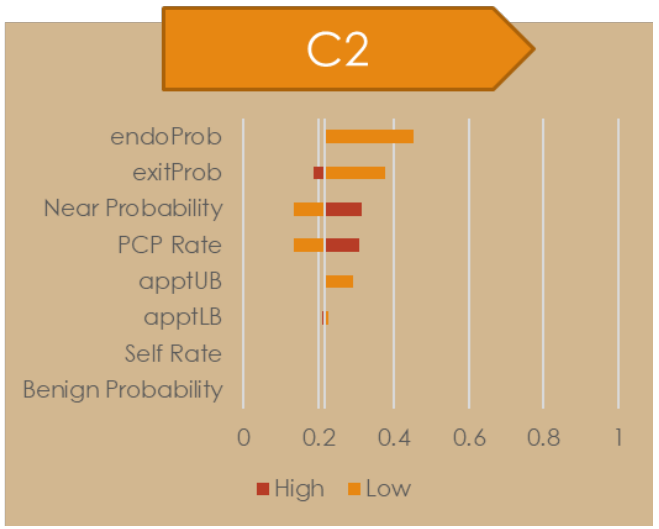












Considerations: Telehealth Utilization

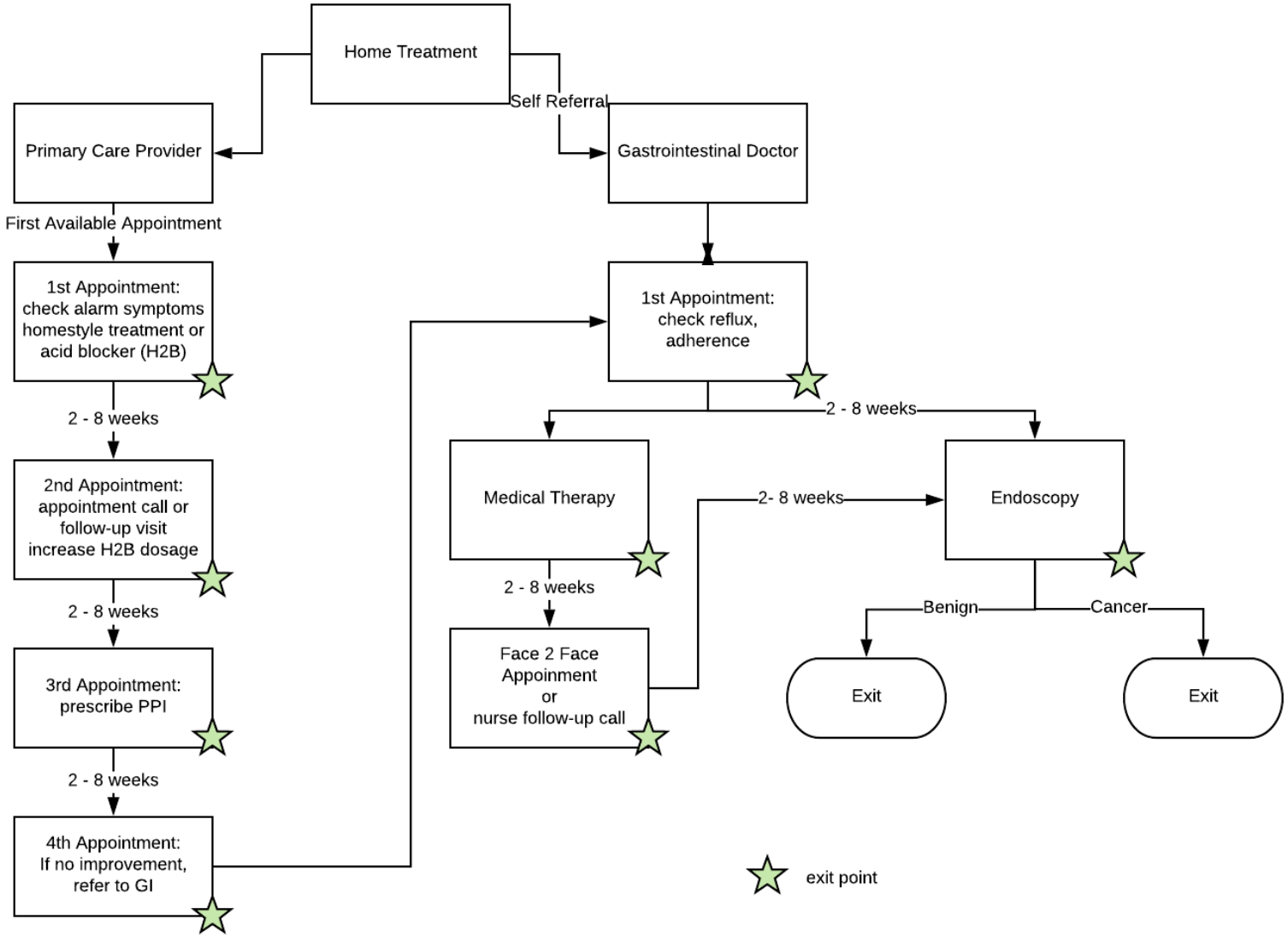
- Appointment upper bound strongly influenced Policy A1
- PCP Rate had significant influence over In Range Policy A
- Telehealth utilization was extremely variable
  - A1 had an average telehealth utilization of 0.9
  - A2 had an average telehealth utilization of 0.35
  - B1, B2, C1, and C2 had an average telehealth utilization of 0.2

Conclusions & next steps

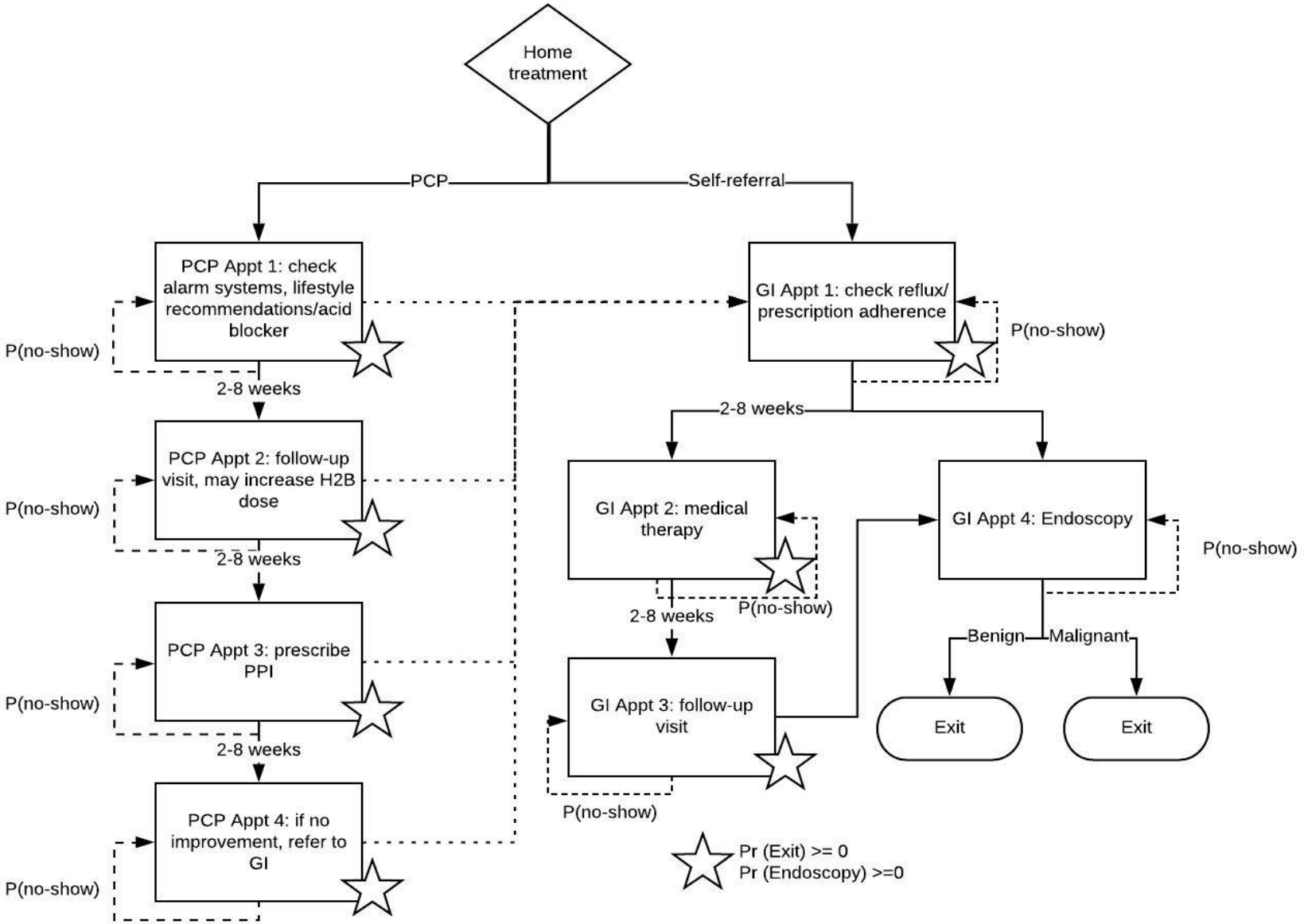
- Telehealth helps reduce barriers to accessing healthcare for rural populations
- Appropriate scheduling policies explicitly allow us to accommodate patient preferences for appointment modalities

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

Current Patient Flow



Planned Future Patient Flow



Transition Probability Matrix

		Going to								
Starting at		PCP1	PCP2	PCP3	PCP4	GI1	GI2	GI3	GI4	Exit
	PCP1	$P_{no\text{-}show}$	$P_{PCP1\text{-}PCP2}$	0	0	$P_{PCP1\text{-}GI1}$	0	0	$P_{PCP1\text{-}GI4}$	P_{exit}
	PCP2	0	$P_{no\text{-}show}$	$P_{PCP2\text{-}PCP3}$	0	$P_{PCP2\text{-}GI1}$	0	0	$P_{PCP2\text{-}GI4}$	P_{exit}
	PCP3	0	0	$P_{no\text{-}show}$	$P_{PCP3\text{-}PCP4}$	$P_{PCP3\text{-}GI1}$	0	0	$P_{PCP3\text{-}GI4}$	P_{exit}
	PCP4	0	0	0	$P_{no\text{-}show}$	$P_{PCP3\text{-}GI1}$	0	0	$P_{PCP4\text{-}GI4}$	P_{exit}
	GI1	0	0	0	0	$P_{no\text{-}show}$	$P_{GI1\text{-}GI2}$	0	$P_{GI1\text{-}GI4}$	P_{exit}
	GI2	0	0	0	0	0	$P_{no\text{-}show}$	$P_{GI2\text{-}GI3}$	$P_{GI2\text{-}G4}$	P_{exit}
	GI3	0	0	0	0	0	0	$P_{no\text{-}show}$	$P_{GI3\text{-}GI4}$	P_{exit}
	GI4	0	0	0	0	0	0	0	$P_{no\text{-}show}$	0

Acknowledgements

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