### Problem Statement

**Background**
- We have developed optimization-based software to help the Pediatrics Chief Resident build monthly shift schedules for residents in the Pediatric Emergency Department (ED).
- Resources available for these schedules depend on decisions made at a higher level when block scheduling the entire Peds residency program.
- We use simulation along with this optimization tool to show how integrated decision making can lead to easier monthly scheduling.

**Block Scheduling**
- Made once a year, assigns residents to services in the hospital for every month.
- Assigns residents their continuity clinic day

**Shift Scheduling**
- Shift schedules are built each month for the Peds ED.
- Each month has a different mix of interns and senior residents from the block schedule.
- Many ACGME and Hospital rules need to be satisfied
  - No interns can work the first or last shift
  - Interns begin on the 27th of the previous month. We leave some shifts at the end of the month open for interns to fill the next month.

**Motivation**
- Some months we struggle to generate a feasible schedule
- Two main issues we see
  - Not enough residents on Wednesdays due to too many residents having Continuity Clinics scheduled for Wednesday
  - Some months we do not have enough interns to cover the end of the previous month

### Methods

**Shift Scheduling Tool**
- Have a tool in C++/Cplex which takes all ACGME and hospital rules, vacation requests, resident types, continuity clinics, etc and creates a feasible schedule
  - Interactive approach engaging chief resident
  - Quickly build high quality schedule

**Simulation**
- Goal is to determine the odds of generating a feasible schedule with a given number of senior and intern residents
  - For each senior/intern pair run 500 simulations
  - Generate random continuity clinics for each resident
  - Test for a feasible schedule.

### Impact/Results

**Why do we Care?**
- Generating an optimal shift schedule depends on the mix of residents in the ED for a month. Interns have more restrictions on shifts they can work and they begin on the 27th of the previous month.
  - If we have too few interns, we cannot fill all the shifts at the beginning of the horizon
  - If we have too few seniors, we cannot fill the first or last shifts

**Interns and Seniors do not have a 1:1 trade off**
- Replacing one senior with an intern reduces the feasibility of the generated schedules.

**There is a number of total residents that virtually guarantee feasible schedule**
- In this case 13 total residents, results in 90% feasible schedules.

**Consistent numbers lead to better schedules**
- By keeping the number of interns every month consistent, the change of getting a feasible schedule increases
- Average 12 residents per month in the ED. If 1/3 are consistently interns, then 87.80% of schedules are feasible.

**Scheduling of Continuity Clinics is important**
- Need to factor in the continuity clinics when generating the Block Schedule.
- Multiple people having continuity clinic in the same day will make it difficult to generate feasible schedule.
- If you know the continuity clinics before the block schedule, you can schedule residents by clinic day
  - Spread out residents with same clinics

### Acknowledgements

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**Percentage of Reps Feasible (N = 500)**

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**Senior Residents**
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