Improving Patient Flow in an Outpatient Infusion Center
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Infusion Process Overview:
- Patient Arrives
- Labs Collected
- Clinic Appointment
- Pharmacy
- Infusion
- Patient Discharged

Lab Process Analysis
- Background:
  - Lab results need to be available before a provider can assess a patient in clinic, the pharmacy can begin drug preparation for infusion patients, and nurses can administer infusions to patients
- Methods:
  - Mapped process from patient arrival to lab resulted for three common infusion labs (CBCD, CMP, Type and Screen)
  - Explored idea of uncoupling patient visits meaning labs would be done the day before an appointment
- Findings:
  - Each of the three labs’ average processing times exceeded the one hour target turnaround time used for scheduling
  - Patient travel time results:
    | Driving Duration | Percent of Patients to Closest Lab Facility |
    |------------------|--------------------------------------------|
    | Less than 15 min | 32%                                        |
    | 15 – 30 min      | 20%                                        |
    | 30 – 60 min      | 23%                                        |
    | 1 – 2 hours      | 15%                                        |
    | 2 – 4 hours      | 7%                                         |
    | Over 4 hours     | 3%                                         |

Pharmacy Pre-mix Tool
- Background:
  - Pharmacy often does not prepare a patient’s drug in advance due to the expensive, toxic, and unstable nature of many chemotherapy drugs
  - Prepping additional drugs in advance can reduce patient wait times and level pharmacy’s workload
- Methods:
  - Identifying additional drugs to be prepared during make ahead time and creating formulation to rank drugs in order to be mixed

<table>
<thead>
<tr>
<th>Input</th>
<th>Effect on Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drug cost</td>
<td>Low cost → Higher priority</td>
</tr>
<tr>
<td>Probability of deferral or dosage change</td>
<td>Low probability → Higher priority</td>
</tr>
<tr>
<td>Number of patients receiving drug</td>
<td>Higher number of patients → Higher priority</td>
</tr>
<tr>
<td>Drug shelf life (hang by/expiration)</td>
<td>Long shelf life → Higher priority</td>
</tr>
<tr>
<td>Drug compounding time</td>
<td>Possibly short compounding time → Higher priority</td>
</tr>
<tr>
<td>Appointment time</td>
<td>Early appointment time → Higher priority</td>
</tr>
<tr>
<td>Length of infusion</td>
<td>Long infusion → Higher priority</td>
</tr>
</tbody>
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Infusion Scheduling
- Background:
  - Chemotherapy treatment demands often exceeds ambulatory infusion capacity
  - Currently patients wait on average 45 minutes from arrival in infusion until they are seated in an infusion chair
  - Improved scheduling of infusion patients can lead to improved utilization of infusion resources resulting in reduced total length of day of operations and patient wait time
- Methods:
  - Used stochastic optimization to generate infusion patient appointment schedules which were evaluated through a discrete event simulation model
  - Optimization Model:
    - Minimize:
      - Trade-off between expected patient wait time and expected overtime
    - Subject to:
      - Patients are assigned to a time and a chair
      - Patients wait until a nurse and a chair are available
      - The day ends when the last patient is discharged
- Findings:
  - Scheduling patients with longer infusion times earlier in the day results in reduced total length of day operations and patient wait time

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