Improving patient flow in an outpatient chemotherapy infusion center

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Introduction

The flow through an outpatient chemotherapy infusion center contains elements of randomness throughout the process. This can cause disruptions that lead to patient delays and overtime for the staff. We study the full process experienced by infusion patients in the University of Michigan Comprehensive Cancer Center, identify key bottlenecks within this process, and develop engineering-based techniques aimed at reducing patient delays and improving staff workload balance.

Project A: Infusion Scheduling

**Background:** Patients wait ~45 minutes after arrival at infusion before being seated in a chair, due to high treatment time variability. Improved scheduling of infusion patients could result in reduced total length of operations and patient wait time.

**Methods:** Considering patient acuity, age, and other characteristics can be used to tailor appointment lengths to each patient. Using appointment templating, more consistent and reliable schedules can be created for patients.

**Current Work:** Incorporate patient acuity into model, develop and implement scheduling guidelines.

Project B: Pharmacy Pre-Mix Tool

**Background:** Infusion drugs are expensive and their use uncertain (e.g. patient cancellation). Thus, pharmacy does not prepare most drugs in advance. “Pre-mixing” may help improve patient waiting times/workload balance.

**Methods:** Collected and analyzed data on prices, treatment times, deferral rate, etc.

**Current Work:** Developing optimization model to determine which drugs should be prepared in advance.

Project C: Lab Process Analysis

**Background:** Lab results are needed by the provider before a clinic appointment to assess the patient and by the pharmacy to initiate drug preparation/infusion process. We are concerned about: patient waiting time, balanced phlebotomist workload, and lab results being available within 1 hour.

**Methods:** Workflow analysis and time study of blood draw area, discrete event simulation of patient flow through area, and Table Top Simulation for education and brainstorming.

**Findings:** Total processing time (blood draw and lab analysis) exceeds 1 hour (blood draw alone accounts for 34.12 min, on average).

<table>
<thead>
<tr>
<th>Step</th>
<th>Mean Time (Std Dev) in Minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient waits for check-in</td>
<td>2.67 (3.92)</td>
</tr>
<tr>
<td>Check-in</td>
<td>3.27 (2.15)</td>
</tr>
<tr>
<td>Patient waits for call back</td>
<td>4.38 (5.64)</td>
</tr>
<tr>
<td>Blood draw</td>
<td>Vein: 5.11 (3.75) Port: 13.28 (4.54)</td>
</tr>
<tr>
<td>Batch</td>
<td>15.16 (4.15)</td>
</tr>
<tr>
<td>Prepare and send capsule</td>
<td>1.49 (1.03)</td>
</tr>
</tbody>
</table>

**Current Work:** Developing a discrete-event simulation of the current state to test and measure the impact of different future/“what if” scenarios on the patient flow, waiting times, and resource utilization percentages. These scenarios will include changes in existing staff roles and their tasks, phlebotomist’s work flow, and the layout of the phlebotomy station.

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Figure 1: Process flow overview.

Figure 2: Description of model formulation.

Figure 3: Prototype of infusion appointment scheduling tool.

Table 1: Time study results.

Table 2: Factor influence on objective function.