An Approach to Improve Chemotherapy Make-Ahead Policies

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Outline

• Background
• Proposed Solution
• Method
• Case Study
• Conclusion
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Pharmacy Flow

- **Order Made Ahead?**
  - Yes: Wait for "Ready To Treat Status" → Triage (By Ready To Treat Time) → Safety Check → Drug is Ready
  - No: Clinical Pharm Release
    - Yes: 1 Verification
    - No: Triage (By Ready to Treat Time)
      - Yes: Omnicell Drug?
        - Yes: Drugs Are In Omnicell
        - No: Patient’s Plan?
          - Yes: Therapy Plan (Non-Chemo) → Release → 1 Verification
          - No: Treatment Plan (Chemo) → Release → 2 Verification
      - No: "Med Release"
        - Dosage Verification (Print Labels)
        - Drug Preparation
        - Dosage Checks
        - Drugs Placed in parking lot
        - Safety Check
        - Drug is Ready
Pharmacy Flow

Order Made Ahead?

Yes: Wait for "Ready To Treat Status" → Triage (By Ready To Treat Time) → Safety Check → Drug is Ready

No: Clinical Pharm Release

Yes: 1 Verification

No: Triage (By Ready to Treat Time)

Omnicell Drug?

No: Treatment Plan (Chemo) → Release → 2 Verification

Yes: Drugs Are In Omnicell → Therapy Plan (Non-Chemo) → Release → 1 Verification

"Med Release"

Dosage Verification (Print Labels)

Drug Preparation

Dosage Checks

Drugs Placed in parking lot

Safety Check

Drug is Ready
What is Pre-mix?

- A drug that is made before any patient is deemed ready to receive it
- Pharmacies tend not to pre-mix drugs due to risk in wastage cost
  - Limited shelf-life
  - Deferrals and no-shows
Current Pre-mix Policy

• University of Michigan Cancer Center’s Current Pre-mix Policy
  – Only mix drugs during a fixed window of time before patients arrive
  – Use a fixed list of drugs they are willing to pre-mix, based on cost and common use according to pharmacists experience
Potential Opportunities for Improvement

- Different clinics operate on different days of the week
  - Patients with similar or the same types of cancers receive similar or the same types of treatment

- Correlation between the type of chemotherapy drugs administered and the days of the week
Motivation

• **Long patient waiting times** for drugs to be mixed
• **High variability in pharmacy workload** during the day
  – Slow during the morning
  – Extremely busy during the afternoon
• **High cost of wasted drugs** for patients who fail to show up or are deferred
Goal

Reduce patient waiting time by mixing chemotherapy drugs before patients arrive in the system or at earlier stages in the process
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Proposed Solution

Develop a dynamic pre-mix template generator to update the fixed list that the UMRCC currently uses
Outline

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• Solution
• **Method**
• Case Study
• Remarks
Initial Historical Analysis

• DoseEdge Data from March 2015 to March 2017
• Using Excel
  – Create “Look Up” Table
  – Found average counts of each drug for each dose bucket
  – Template uses the average count by day of week, average drug mixing time, and cost
## Look Up Table

<table>
<thead>
<tr>
<th>Dose Description</th>
<th>Drug Name and Dose</th>
<th>Drug Name</th>
<th>Drug Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carboplatin 900mg, dextrose 5% 270mL in 360mL</td>
<td>Carboplatin 900mg</td>
<td>Carboplatin</td>
<td>900mg</td>
</tr>
<tr>
<td>Carboplatin 1000mg, dextrose 5% 270mL in 360mL</td>
<td>Carboplatin 1000mg</td>
<td>Carboplatin</td>
<td>1000mg</td>
</tr>
</tbody>
</table>
### Time Stamp Example

<table>
<thead>
<tr>
<th>Dose Description</th>
<th>Drug Name</th>
<th>Dose</th>
<th>Start Prep Time</th>
<th>Sorted Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carboplatin 900mg, dextrose 5% 270mL in 360mL</td>
<td>Carboplatin</td>
<td>900mg</td>
<td>3/2/2015 9:31</td>
<td>3/2/2015 9:37</td>
</tr>
</tbody>
</table>

- Used to find the average drug demand of each drug and its bucket
- Used to find the average mixing time of each drug and its dose
# Drug Counts by Day and Dose

<table>
<thead>
<tr>
<th>Drug Name</th>
<th>Lower Dose Limit</th>
<th>Upper Dose Limit</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lower Dose Limit</td>
<td>Upper Dose Limit</td>
<td>7/11/16</td>
</tr>
<tr>
<td>Carboplatin</td>
<td>0</td>
<td>250</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>250</td>
<td>500</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>500</td>
<td>750</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>750</td>
<td>1000</td>
<td>1</td>
</tr>
</tbody>
</table>
Inputs

- Adjustable Parameters
  - Cost
  - Average Demand by Day of Week
  - Average Mixing Time by Dose

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Cost (willingness to expend to reduce wait time)</th>
<th>Demand (from historical data)</th>
<th>Mixing Time (from historical data)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monday</td>
<td>Tuesday</td>
<td>Wednesday</td>
<td>Thursday</td>
</tr>
<tr>
<td>---------------------</td>
<td>--------------------</td>
<td>-------------------</td>
<td>--------------------</td>
</tr>
<tr>
<td>Bortezomib &lt; 2.5</td>
<td></td>
<td>Bortezomib &lt; 2.5</td>
<td></td>
</tr>
<tr>
<td>Carboplatin &lt; 1000</td>
<td>Carboplatin &lt; 1000</td>
<td>Carboplatin &lt; 1000</td>
<td>Carboplatin &lt; 1000</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cisplatin &lt; 1000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ifosfamide &lt; 3000</td>
<td>Ifosfamide &lt; 3000</td>
<td>Ifosfamide &lt; 3000</td>
<td>Ifosfamide &lt; 3000</td>
</tr>
<tr>
<td>Oxaliplatin &lt; 500</td>
<td>Oxaliplatin &lt; 500</td>
<td>Oxaliplatin &lt; 500</td>
<td></td>
</tr>
<tr>
<td>Vinblastine &lt; 10</td>
<td></td>
<td>Vinblastine &lt; 10</td>
<td></td>
</tr>
</tbody>
</table>
Template Summary

• Iterative: intended to be regenerated
  – Change in patient population, staffing schedules, and clinic days
• Can be adjusted for seasonality
• Adjustable parameters
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Test Case

• Applied the dynamic template to a single week to determine if an improvement was made
  – Cost: $10,000
  – Average Mixing Time: 5 minutes
  – Average Count: 1.5 doses

• Review drug orders and waste logs over the same week for comparison
Case Study Results

Template Comparison: The Percentage of Drugs Pre-mixed (July 11th – 16th, 2016)

- Both Don't Pre-mix
- Both Pre-mix
- UMRCC Pre-mix
- Dynamic Template Pre-mix
## Case Study Results

<table>
<thead>
<tr>
<th>Metric</th>
<th>UMRCC Template</th>
<th>Dynamic Template</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Number of Drugs Pre-mixed</td>
<td>73</td>
<td>96</td>
<td>+23</td>
</tr>
<tr>
<td>Weekly Waste Cost</td>
<td>$130.27</td>
<td>$89.38</td>
<td>-$40.89</td>
</tr>
<tr>
<td>Weekly Time Saved (hours)</td>
<td>≥ 24.4</td>
<td>≥ 29.2</td>
<td>+5.2</td>
</tr>
</tbody>
</table>
Waiting Time Saved Result

• Saved time is more than just 5.2 hours
  – Based on the time it takes to mix a patients drug
  – Mixing a drug earlier means that other drugs can, in turn, also be mixed earlier
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Conclusion

- Dynamic templates have the potential to reduce both patient waiting times and pharmacy waste cost
- Templates can be updated with newer data
- Easily implemented tool for pharmacists to reference
Future Work

• Evaluate template performance using simulation discussed in “Improving Chemotherapy Make-ahead Policies through Discrete-event Simulation” – Donald Richardson
  – Potential to reduce costs further after patient probability of deferral is accounted for
• Develop macro to automate template-making process
• Sensitivity Analysis
Questions

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