MICHIGAN ENGINEERING
UNIVERSITY OF MICHIGAN

An Approach to Improve Chemotherapy Make-Ahead Policies

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CENTER FOR
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Outline

- Background
- Proposed Solution
- Method
- Case Study
- Conclusion

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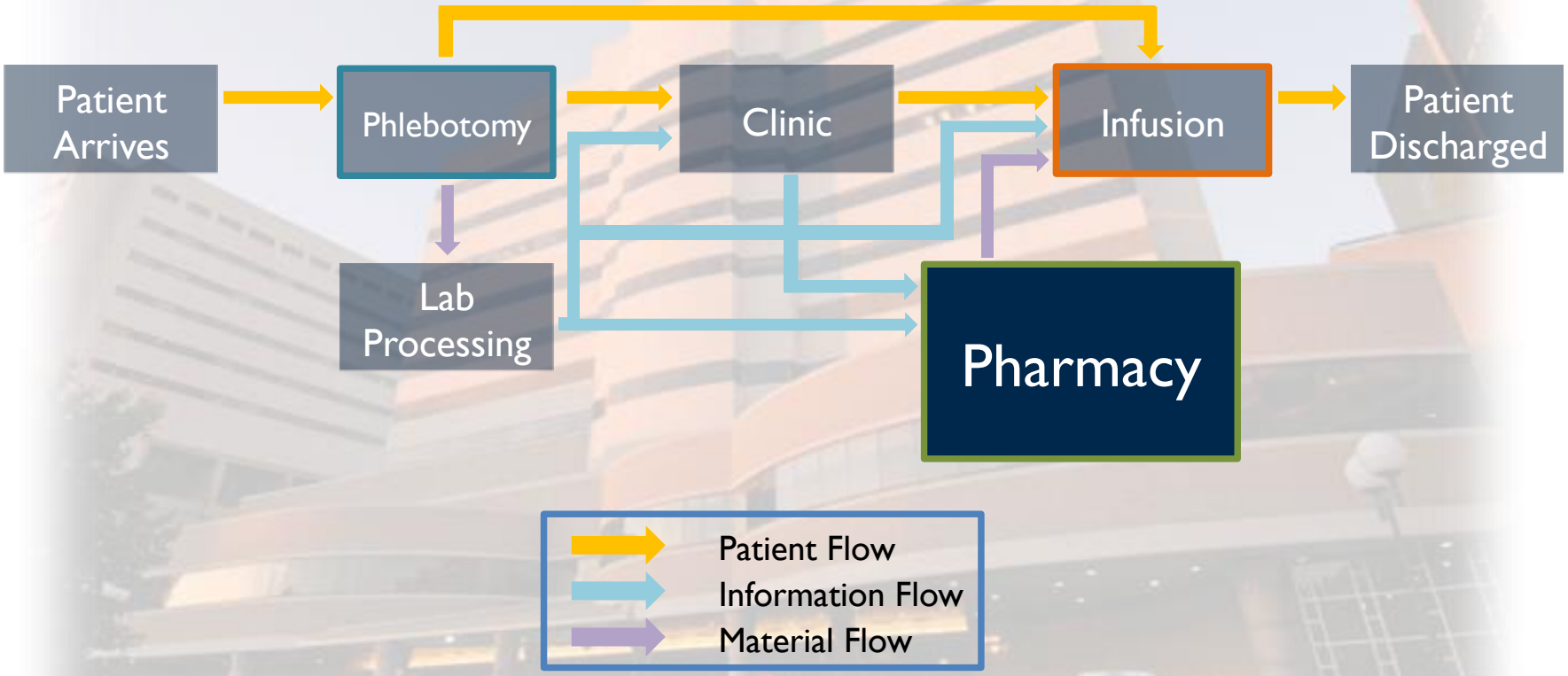
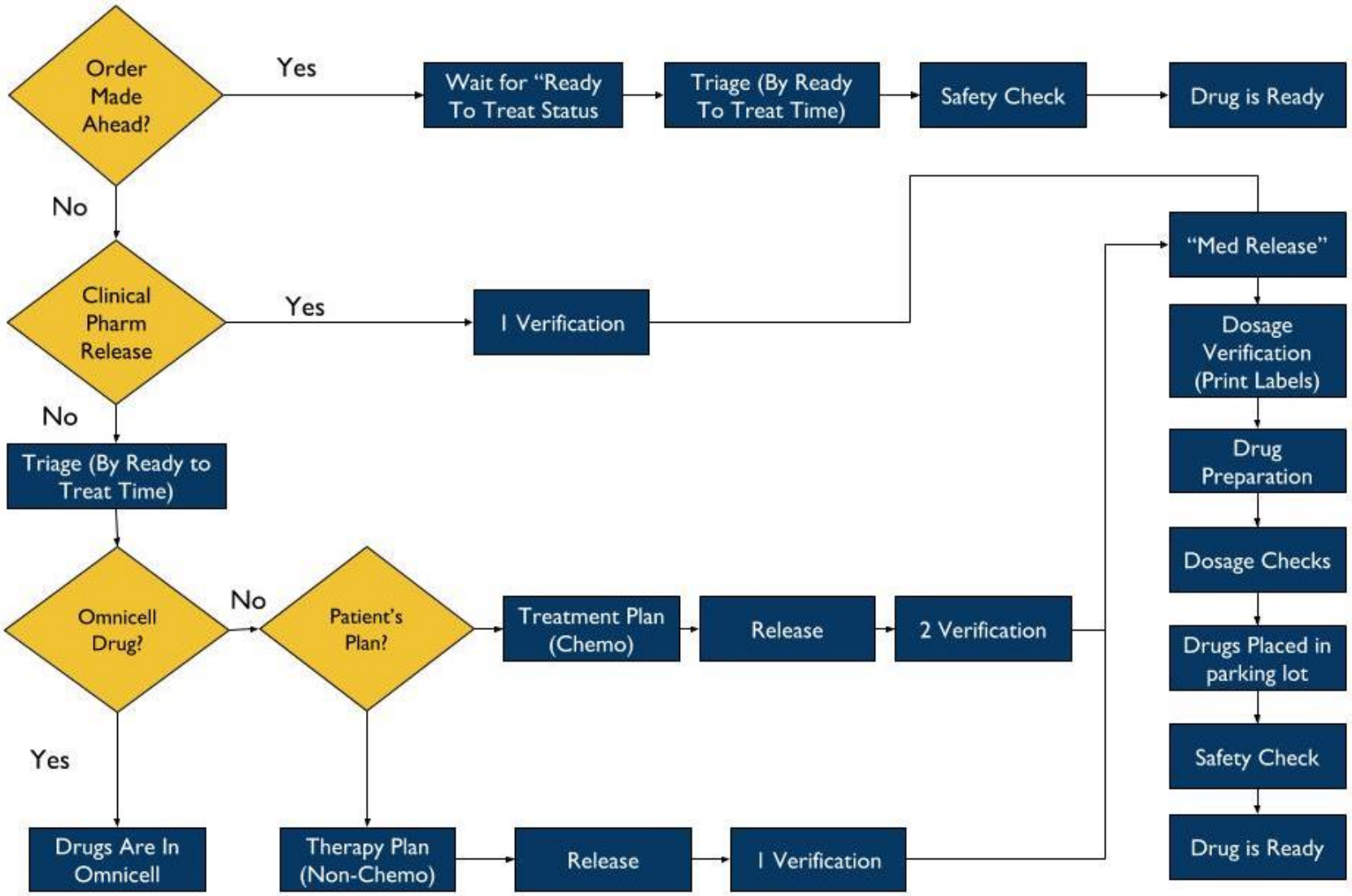
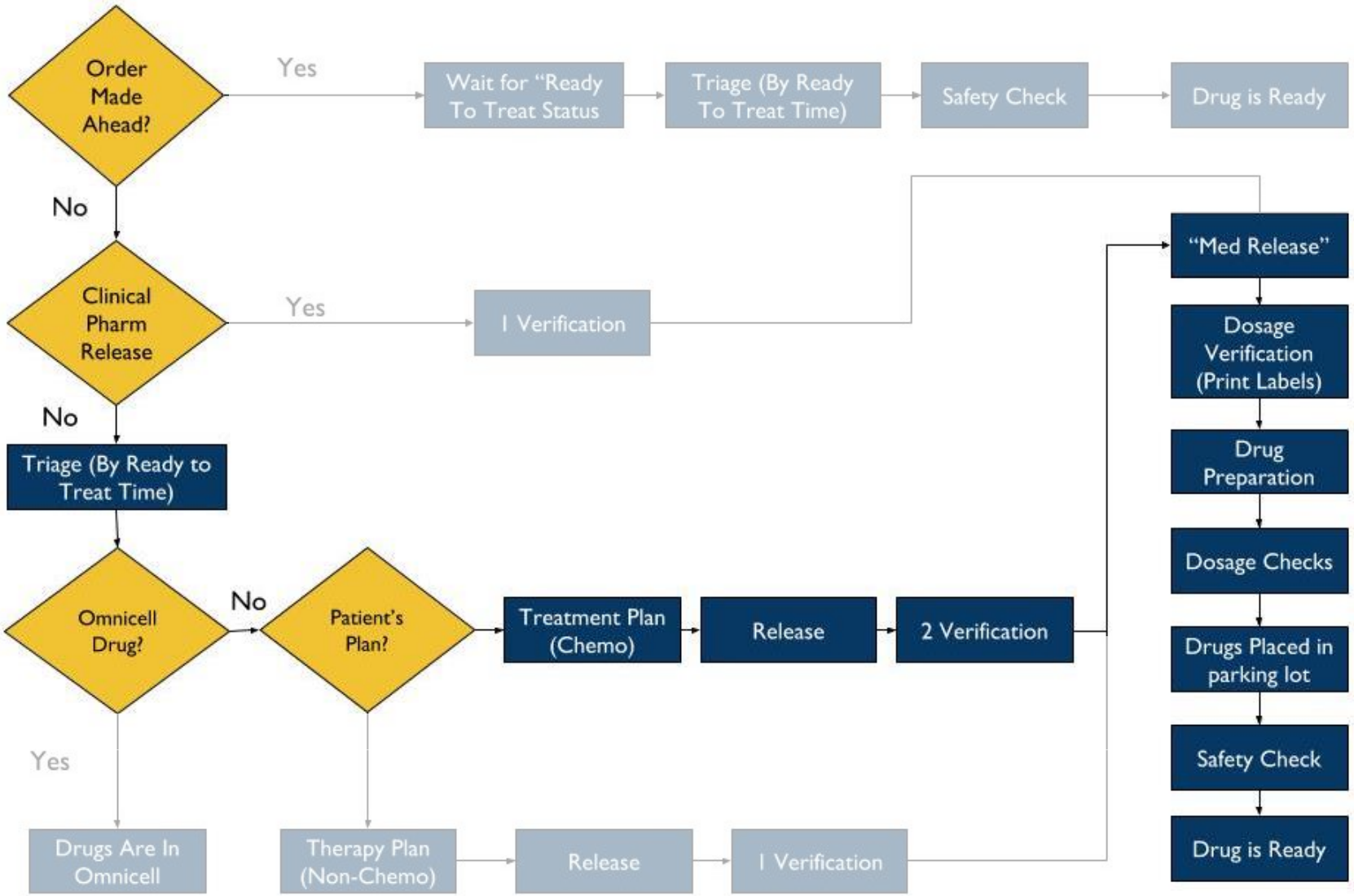
Cancer Center Flow



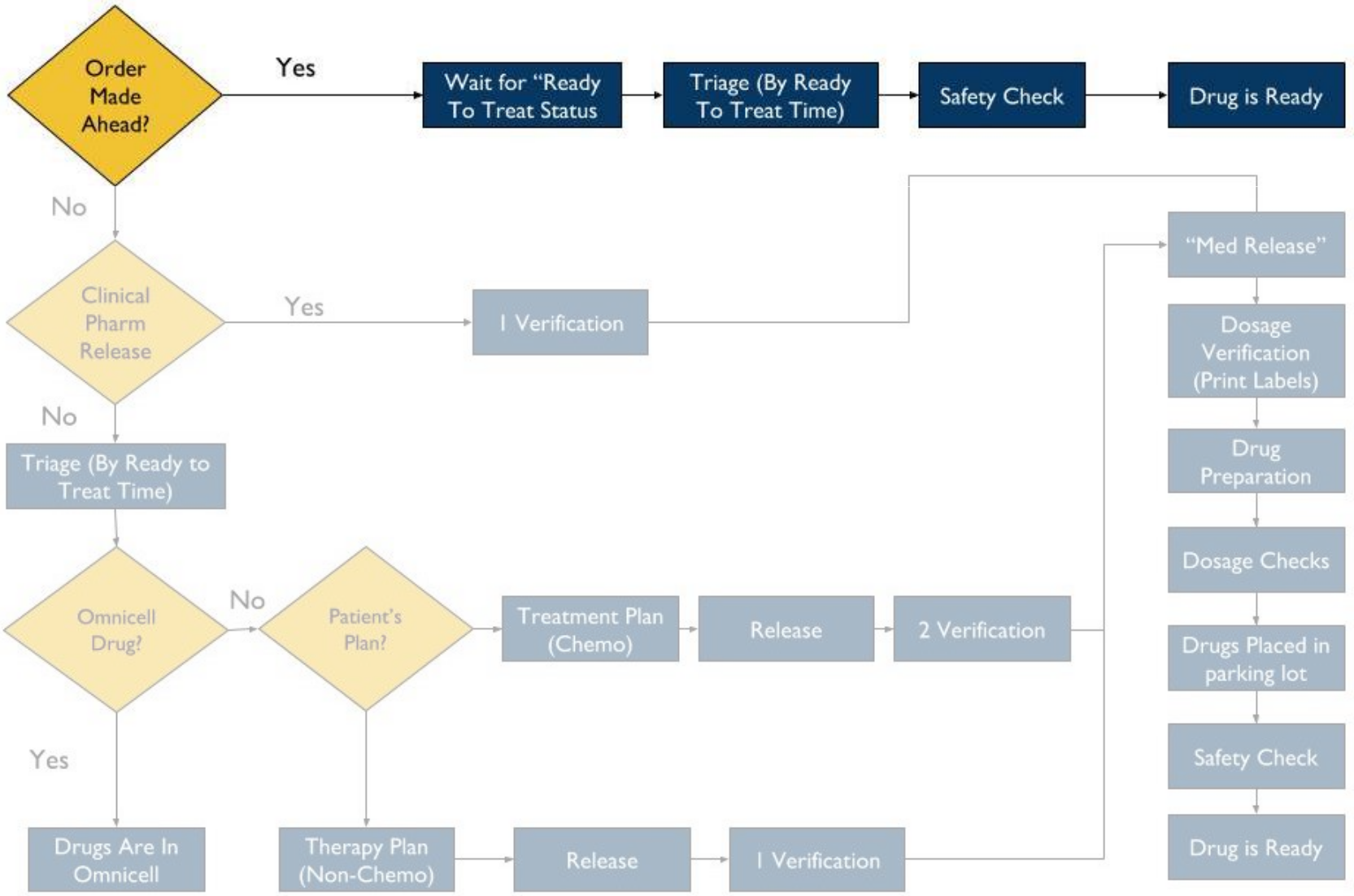
Pharmacy Flow



Pharmacy Flow



Pharmacy Flow



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

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- 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

Dose Description	Drug Name and Dose	Drug Name	Drug Dose
Carboplatin 900mg,dextrose 5% 270mL in 360mL	Carboplatin 900mg	Carboplatin	900mg
Carboplatin 1000mg,dextrose 5% 270mL in 360mL	Carboplatin 1000mg	Carboplatin	1000mg

Time Stamp Example

Dose Description	Drug Name	Dose	Start Prep Time	Sorted Time
Carboplatin 900mg, dextrose 5% 270mL in 360mL	Carboplatin	900mg	3/2/2015 9:31	3/2/2015 9:37

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

Drug Name	Lower Dose Limit	Upper Dose Limit	Date					
			7/11/16	*7/12/16*	*7/13/16*	*7/14/16*	*7/15/16*	*7/16/16*
Carboplatin	0	250	6	8	1	1	3	1
	250	500	1	6	1	1	3	1
	500	750	1	2	0	1	2	0
	750	1000	1	0	0	0	0	0

Inputs

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

Parameters		
Cost (willingness to expend to reduce wait time)	Demand (from historical data)	Mixing Time (from historical data)

Example Output

Monday	Tuesday	Wednesday	Thursday	Friday
Bortezomib < 2.5		Bortezomib < 2.5		Bortezomib < 2.5
Carboplatin < 1000	Carboplatin < 1000	Carboplatin < 1000	Carboplatin < 1000	Carboplatin < 1000
			Docetaxel < 150	Docetaxel <150
	Cisplatin < 1000			Cisplatin < 1000
				Cisplatin < 100
	Ifosfamide < 3000	Ifosfamide < 3000	Ifosfamide < 3000	Ifosfamide < 3000
Oxaliplatin < 500	Oxaliplatin < 500	Oxaliplatin < 500		Oxaliplatin < 500
Vinblastine < 10		Vinblastine < 10		Vinblastine < 10

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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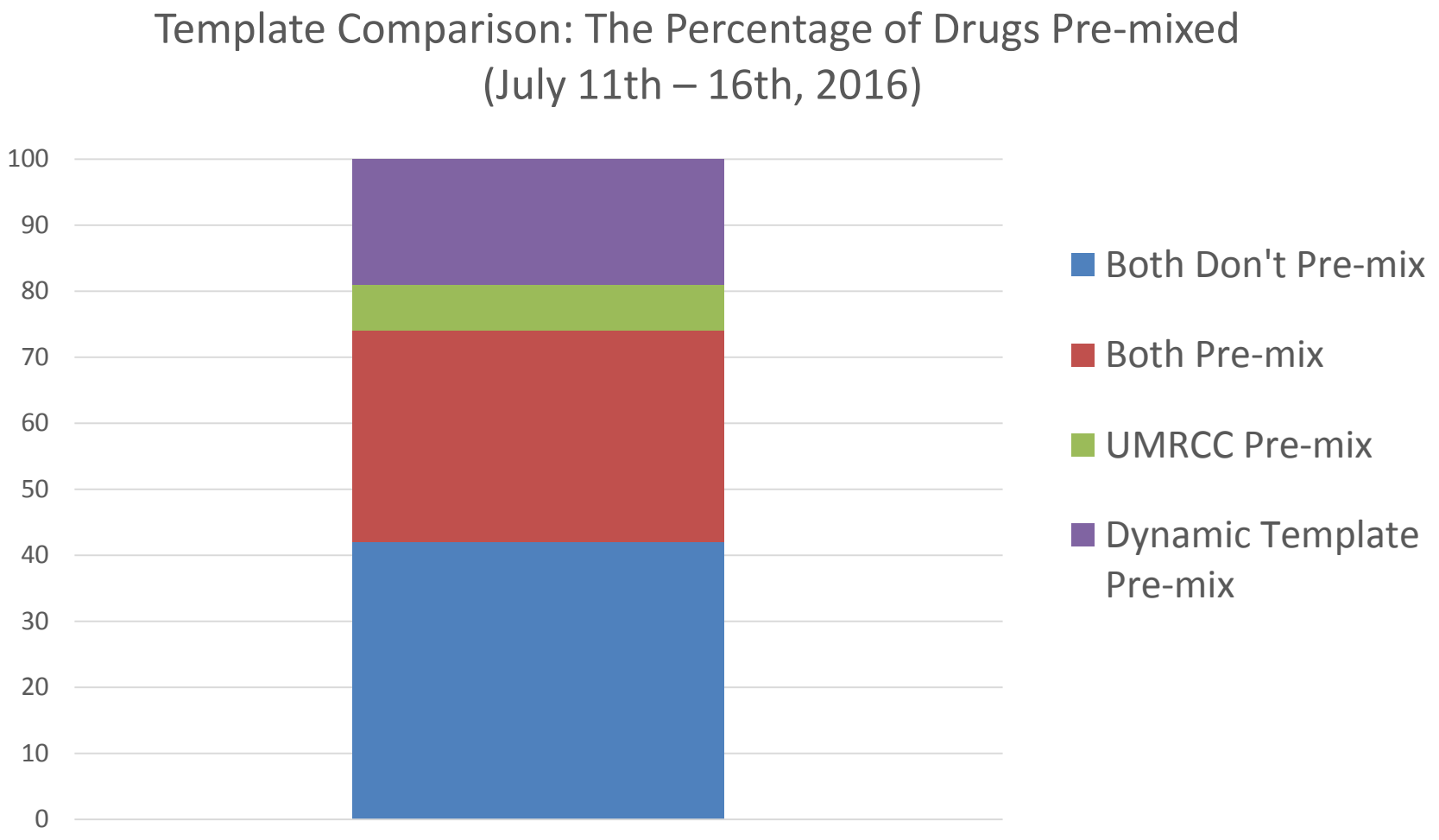
Test Case

- 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



Case Study Results

Metric	UMRCC Template	Dynamic Template	Change
Total Number of Drugs Pre-mixed	73	96	+23
Weekly Waste Cost	$130.27	$89.38	-$40.89
Weekly Time Saved (hours)	≥ 24.4	≥ 29.2	+5.2

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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