

## A Dynamic Approach to Improve Chemotherapy Pre-mix Policies

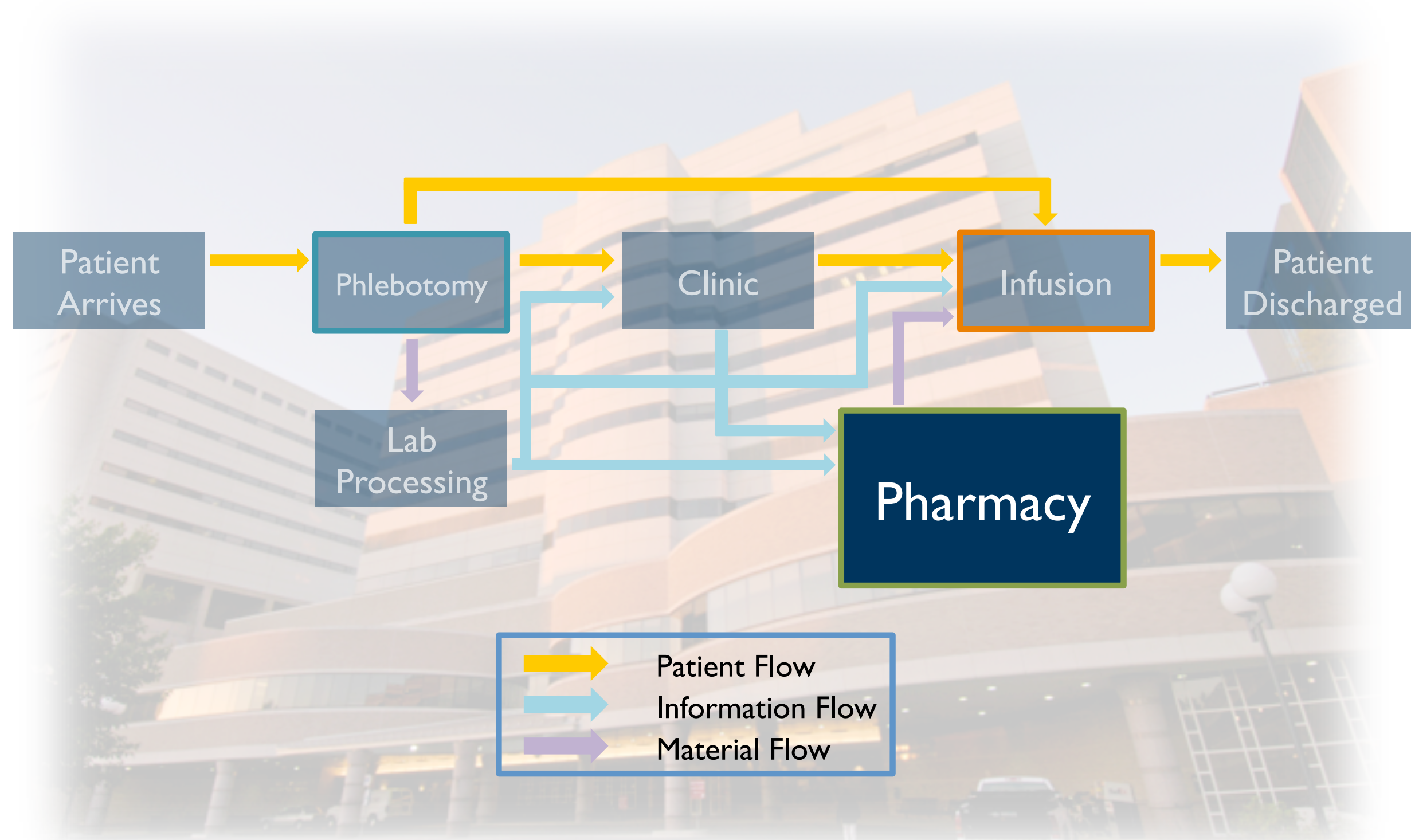
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### Problem Statement

**Key Goal:** Reduce patient waiting time by mixing chemotherapy drugs before patients arrive in the system or at earlier stages in the process

**Motivation:**

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



### What is Pre-mix?

- A drug is considered pre-mixed if it is made before any patient is deemed ready to receive it
- Pharmacies tend not to pre-mix drugs due to risk in wastage cost

### Current Pre-mix Policy

**Univ. of Michigan Comprehensive Cancer Center (UMRCC)**

**Current Pre-mix Policy:**

- Will only mix drugs during a fixed window of time (6AM-7:30AM) 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

**Oversights of Current Pre-mix Policy:**

- Does not take into account that 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 treatments

### Proposed Solution

**Solution:** Develop and implement a dynamic pre-mix template generator to update the fixed list that the UMRCC currently uses. This template accounts for different patient populations, drug costs, and mixing times on different days of the week.

**Dynamic Template Parameters:** The parameters of the dynamic template can be adjusted.

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

Table 1: The parameters used in the dynamic pre-mix template

**Dynamic Template Testing:**

- Retrospectively compare actual pharmacy productivity with static pre-mix template vs. theoretical pharmacy productivity with dynamic pre-mix template
  - Did applying the dynamic template save the UMRCC pharmacy time (by pre-mixing specific drugs) or money (by decreasing wasted pre-mixed drugs)?

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
				Fluorouracil < 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

Table 2: An example output of our dynamic template to which a pharmacist can refer when prioritizing and verifying orders during the morning pre-mixing process (all drug doses are in milligrams)

**Current State:** UMRCC Pharmacy pre-mixing policy doesn't minimize the patient waiting time.

**Solution:** Implementing a dynamic pre-mix template may decrease wait times, waste costs, and pharmacy workload variability via recommendations of currently unconsidered drugs (e.g., during preliminary analysis, Bortezomib and Oxaliplatin were both shown to be in high demand)

### Results

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

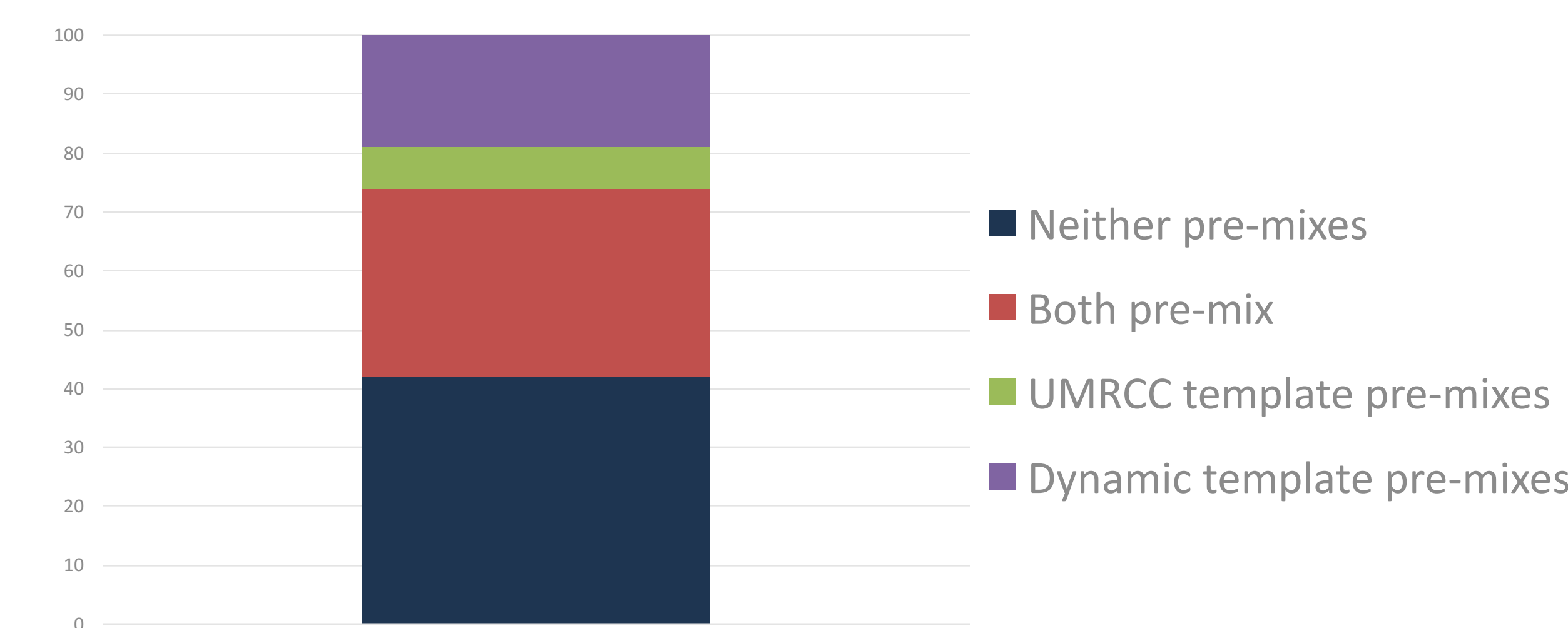


Figure 2: The percentage of drugs pre-mixed by two templates (out of 189 drugs)

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

Table 3: Comparison between the current UMRCC pre-mix policy and the dynamic template. Parameters: Cost Upper Limit = \$10,000, Daily Average Demand Lower Limit = 1, Mixing time Lower Limit = 5 min

### Conclusion

- We show our proposed dynamic template reduces both patient waiting time and pharmacy waste costs (Table 3)
- Our dynamic template varies daily, matching daily provider changes (provider type/specialty correlates with drug demand)
- We propose updating the dynamic template every 6 to 12 months to align with shifting patient populations
- There exists potential to reduce costs further by incorporating patient deferral probabilities

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