

An Adaptable Approach to Improve Chemotherapy Pre-mix Policies

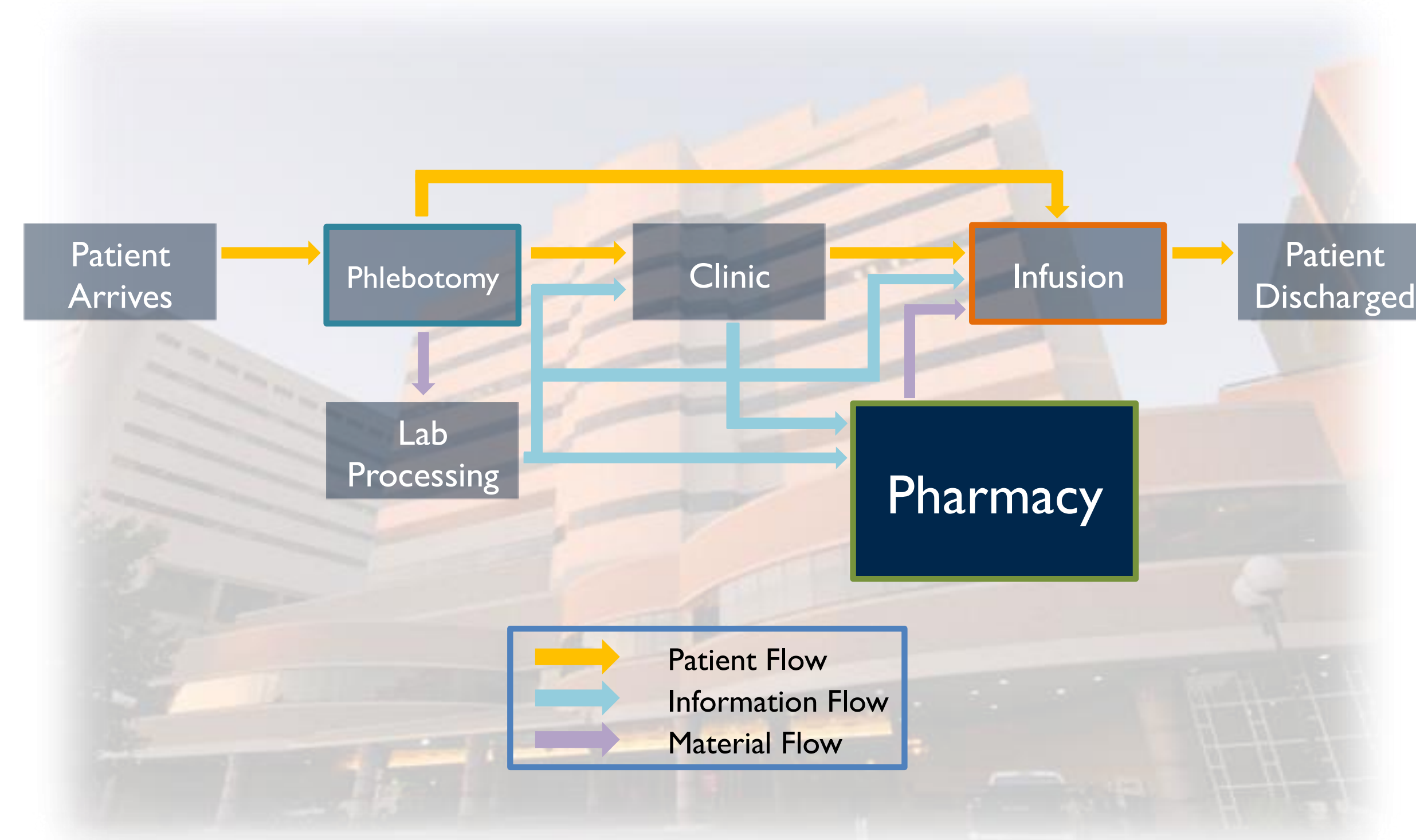
Matthew See, Donald Richardson, Hwon Tak, Amy Cohn PhD

Problem Statement

Key Goal: Reduce patient waiting time by mixing chemotherapy drugs before patients arrive at the infusion stage

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



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

University of Michigan Rogel Cancer Center (UMRCC)

Current Pre-mix Policy:

- Will only mix drugs during a fixed window of time (6AM-8AM) 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
- High variability in pharmacy workload during the day
 - Extremely busy during the afternoon
 - Slower pace during the morning

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:

- Retroactively 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 | | | 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)

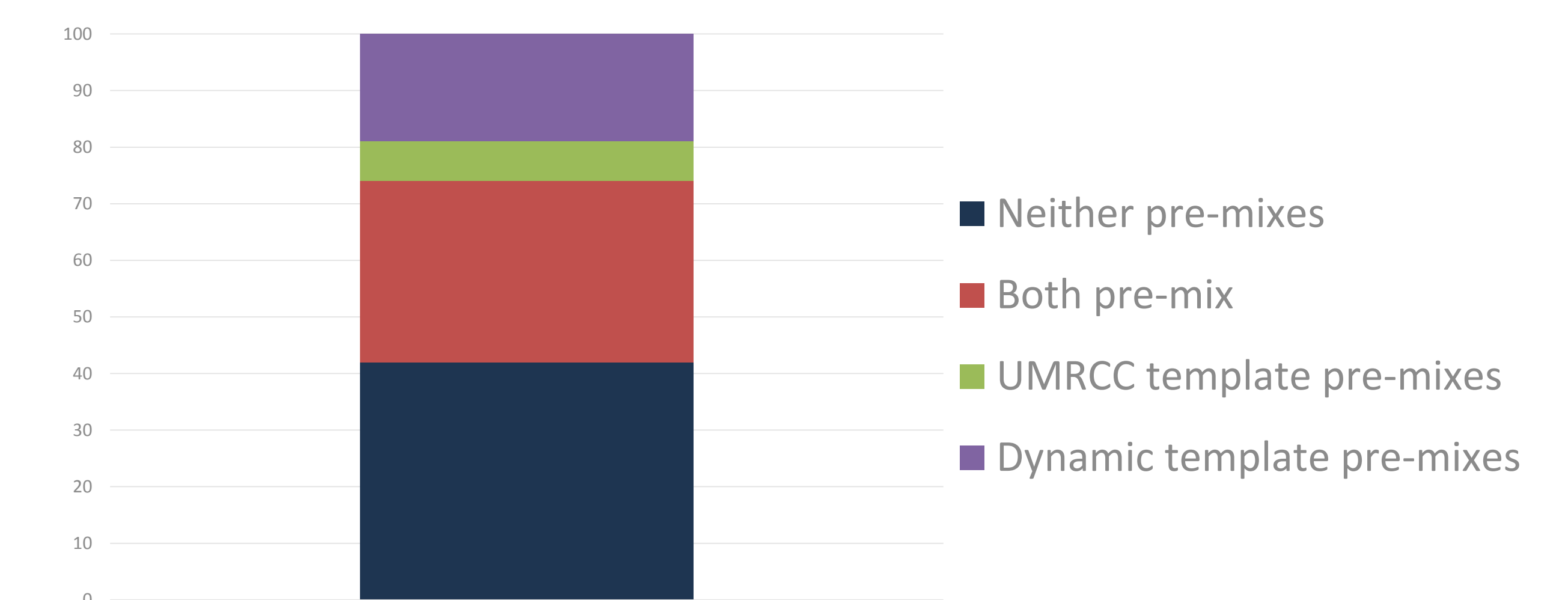


Figure 2: The percentage of drugs pre-mixed by two templates (out of 189)

| 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

Acknowledgements

This research is generously supported by the Center for Healthcare Engineering and Patient Safety (CHEPS) and the Seth Bonder Foundation. Special thanks to our collaborators at the University of Michigan Rogel Cancer Center, especially Carolina Typaldos, Vincent LaRocca, and Anna Kempke. We also thank the entire CHEPS Chemotherapy Project team.