CENTER FOR HEALTHCARE ENGINEERING & PATIENT SAFETY
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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

Univ. of Michigan Comprehensive Cancer Center (UMCCC) 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

Process Flow

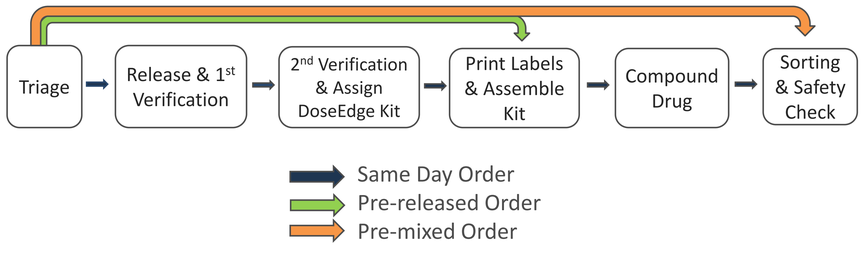

Figure 1: The general flow of a chemotherapy drug through the mixing phase in the UMCCC pharmacy

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
- Currently, pre-mixable drugs must meet strict criteria:
  (1) relatively cheap,
  (2) highly prescribed, and
  (3) stable after mixing

Solution Approach

Solution: Develop and implement a dynamic pre-mix template generator to update the fixed list that the UMCCC 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 UMCCC 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: UMCCC 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)

Impact/Results

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

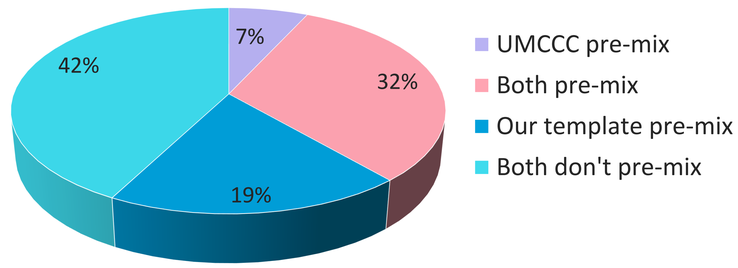

Figure 2: The percentage of the number of drugs pre-mixed by two templates (out of 189)

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

Table 3: Comparison between the current UMCCC pre-mix policy and the dynamic template

Conclusion

- We show our proposed template reduces both patient waiting time and pharmacy waste costs from Table 3
- Our pre-mix template varies by day of week since providers change by day of week (the provider type or specialty is correlated with the drug demand)
- We propose updating the template on a 6-month to yearly basis to address shifting patient populations
- There is potential to reduce costs further once we include patient probability of deferral

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