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IMPROVING MAKE-AHEAD CHEMOTHERAPY DRUG POLICIES AT OUTPATIENT INFUSIONS CENTERS

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ABSTRACT

During an outpatient chemotherapy infusion visit, patients typically have blood work done, see their oncologist in the clinic, wait for the pharmacy to prepare their drugs, and receive their infusion. The time variability at each of these steps can introduce delays, which not only negatively impact the patient but propagate through the system to negatively impact other patients and staff as well. One major opportunity to reduce patient waiting time is by pre-mixing (i.e. making drugs before the patient arrives for their infusion appointment) at the pharmacy. This, however, requires careful consideration of the trade-off between time savings versus the potential cost of wasting a drug if the patient is deemed ineligible for treatment on the day of their appointment. We present a prediction, optimization, and discrete-event simulation model to improve make-ahead drug policies utilizing data from our collaborators at the University of Michigan Rogel Cancer Center (UMRCC).

1 INTRODUCTION

Outpatient chemotherapy infusion is one of the most common forms of treatment used to cure, control, and ease symptoms of cancer. With an estimated 1.7 million new cases of cancer in 2018, over half of these patients will require chemotherapy at some point during their treatment. These drugs generally have high cost and a short shelf life, which requires same-day preparation at the pharmacy.

Patients who require outpatient chemotherapy infusion undergo lengthy and physically demanding infusion sessions over the course of their treatment. While the frequency and duration of visits vary by patient, drug, and cancer type, most patients will require several treatments over the course of months up to a year to complete their regimen. Receiving infusion is just one part of the complex treatment process. Patients may have their blood work done, wait for the results to process, visit their oncologist, wait on their order to be placed by their oncologist and prepared by the pharmacy, and then have the infusion administered. Each step introduces randomness which can lead to propagated delays. These delays negatively affect patients as well as clinical operation cost and staff workload.

2 PROBLEM DESCRIPTION

We focus on optimizing drug preparation at the pharmacy to reduce patient delays. Drugs can be prepared the morning before patients arrive to prevent the patient from waiting the additional time needed to prepare their prescribed drugs in addition to any other wait time occurred during peak pharmacy hours. However, patients scheduled for outpatient chemotherapy infusion sometimes may need to cancel at the last minute even after arriving for their appointment (i.e. patient may be deemed too ill to receive treatment). This results in the health system incurring waste cost if the drug was made ahead since the drugs are patient specific and have a short shelf life. Infusion centers must implement policies to balance this potential waste cost with the time savings for their patients and staff. In support of this effort, my dissertation focuses on

methods and strategies to improve the process flow of chemotherapy infusion outpatients by optimizing pharmacy make-ahead policies.

3 PROPOSED SOLUTION

We propose using three different methods which build upon each other. First we develop a predictive model which utilizes patient-specific data to estimate the probability that a patient will defer or not show for treatment on a given day. Generally, the ability to generate high-quality predictions of patient deferrals can be highly valuable in managing clinical operations, such as scheduling patients, determining which drugs to make before patients arrive, and establishing the proper staffing for a given day. We also introduce how the patient-specific probability of deferral can help determine a "general rule of thumb" policy for what should be made ahead on a given day. Next we utilize these probabilities in an integer programming model. This multi-criteria optimization model prioritizes which and how many drugs to make ahead given a fixed window of time. This is done with the dual objectives of reducing the expected waste cost as well as the expected patient waiting time. Lastly, we utilize simulation to better quantify the impact of our proposed policies. We also use simulation optimization (need to still discuss this more) to explore various dynamic make-ahead policies. Each method utilizes electronic medical record data from the University of Michigan Rogel Cancer Center (UMRCC) but can be generalized for any cancer center.