Proceedings of the 2017 Winter Simulation Conference
W. K. V. Chan, A. D'Ambrogio, G. Zacharewicz, N. Mustafee, G. Wainer, and E. Page, eds.

ADAPTIVE RESOURCE MODELING TO REDIRECT STAKEHOLDER PERCEPTION OF BOTTLENECKS

Christina Mouradian
Martin E. Doerfler

Improvement Sciences
Department of Clinical Transformation
Northwell Health
1985 Marcus Avenue, Suite LL104
Lake Success, NY 11042, USA

Shaghayegh Norouzzadeh
Nancy Riebling

Department of Information Systems and Business Analytics
Zarb School of Business
Hofstra University
1000 Fulton Avenue
Hempstead, NY 11549, USA

ABSTRACT

Discrete event simulation can be utilized as a primary resource to aid critical decision-making throughout the healthcare industry. Due to the inherent complexity within this domain, effective change is highly dependent on the partnership that exists between the health system engineers and their stakeholders. An outpatient endocrinology clinic faced a problem with extended waiting times, on average 34 minutes, above the 15 minute benchmark for patients to be seen. This study uses an adaptive resource modeling approach coupled with a key partnership to identify bottlenecks and test improvement scenarios within the endocrinology clinic. Key performance indicators were traced through the simulation model to enhance system performance and optimize resource utilization. Based on the findings various improvement scenarios were proposed such as modifying resource scheduling, patient volume and resource capacity. Ultimately, the optimal improvement option presented a 30.7%, 8.5% and 46% improvement in wait time, provider efficiency and patient throughput, respectively.

1 INTRODUCTION

Due to the competitive nature of the healthcare industry, critical decision-making has become a fundamental driver to succeed. Simulation has the power to aid critical decision-making by allowing key process parameters to be altered providing healthcare professionals with the opportunity to analyze and observe changes within the system. In order to achieve the vision of embedding simulation into the toolkit of critical decision-making in healthcare, a partnership must be formed between process stakeholders and the health system engineers who are responsible for developing the simulation model. Obtaining support for change is an essential component in order to reach mutually agreeable solutions and long-term simulation reliance.

The setting of this case study was in an outpatient endocrinology clinic in which patients wait on average 34 minutes before they see their provider impacting the clinic's patient satisfaction scores. The clinic operated at a 46% defect rate, using the benchmark of 15 minutes, ultimately directing the primary focus of the simulation study to reduce the time patients wait before their scheduled appointment. A partnership between the multidisciplinary team of the clinic and external health system engineers worked together utilizing an adaptive resource modeling approach to achieve three primary objectives: 1) Reduce waiting time for patients 2) Improve physician and medical office assistants (MOA) utilization and 3) Improve clinic capacity.

2 SIMULATION METHODS

A three phase approach was utilized to model the endocrinology clinic where key stakeholders, physicians, nurse educators, bone density technicians, MOAs, phlebotomists and clerical staff, were involved throughout each phase developing a partnership between stakeholders and health system engineers. Phase one consisted of mapping the conceptual process flow, discussing the necessary data and finally collecting the data. Data was collected for one month to ensure it was adequate and representative of the current process. The data collection was comprised of various turnaround times for key process steps, such as the time for patient check-in, intake, treatment and check-out. The key process steps were defined from the subject matter experts through utilization of the process map. This data was collected for the purposes of understanding baseline performance through descriptive statistics and analysis as well as in phase two. Phase two included statistical distribution fitting, developing the baseline model and validating the model. Finally, phase three included developing multiple test scenarios, running and analyzing the impact of the test scenarios and ultimately deciding which scenario to pilot. The discrete event simulation model was developed using ExtendSim 9.2.

Providers and MOAs were dynamically scheduled throughout the day as well as throughout the week causing extreme variability in patient scheduling. This fluctuation in the number of resources available per hour per day was factored into the model using an adaptive resource scheduling approach. This approach accounted for the dynamic changes in resource staffing throughout each hour of the day and all days of the week. The number of physicians, the number of MOAs and the number of rooms available, dynamically changed throughout the simulation run. Patient arrival patterns were fit to distributions and separated into five different time blocks each block accounting for two hours of the work day. Furthermore, patient waiting times were modeled at various points throughout the simulation to capture where bottlenecks in the system were. The simulation ran for 52 weeks and was replicated ten times.

3 RESULTS

Key parameters were captured to understand the system's baseline performance including resource utilization, waiting times and the overall throughput of the process. The model's baseline performance resulted in room, physician and MOA utilization to be 87%, 83% and 23%, respectively. Patients waited on average 26 minutes with a standard deviation of 21 minutes in the waiting room and an average of 9 minutes with a standard deviation of 7 minutes in the exam room. Lastly, the overall throughput was 306 patients per week. Model validation was performed to ensure the model was an accurate representation of the actual process by comparing the baseline model results against the raw data. Key stakeholders questioned whether the baseline results were an accurate representation of their current process as MOA utilization was extremely low. The simulation model gave insight into the low MOA utilization and highlighted inefficiencies related to assigning MOAs to physicians. As a result health system engineers worked with key stakeholders to do an additional manual data collection specifically focusing on MOA workflow as well as developing a master schedule including both provider and MOA schedules. Clear gaps in time were depicted validating the MOA model utilization. Stakeholders were able to come to the realization that the model was an accurate reflection of their current process. A variety of improvement scenarios were proposed by the clinical experts and tested by changing key model inputs including physician clinical capacity, patient volume and patient scheduling. The number of scheduled patient appointments were not aligned to physician availability. The proportional alignment balanced out physician workload allowing patients to arrive in the simulation model at a rate proportional to physician availability. By proportionately aligning patient schedules with physician schedules, increasing provider clinical hours by 40 hours per week and increasing patient volume by 25%, the clinic will see an increase in their resource utilization by 6.8%, 8.5%, 130% for room, physician and MOAs, respectively. In addition, they will see a decrease in average waiting time by 30.7% and 66% for waiting in the waiting room and waiting in the exam room before treatment, respectively. Lastly, the clinic will see an increase in their patient capacity per week by 46%.

4 IMPACT AND BENEFITS

The use of simulation and the partnership between health system engineers and key stakeholders throughout the study allowed stakeholders to change their perception of where the bottlenecks within the process were. One of the challenges faced during this study was the lack of a common language between health system engineers and stakeholders. Involving key stakeholders throughout the modeling process helped to create this common understanding, mitigate resistance and obtain support. Furthermore, this key partnership allowed stakeholders to be more receptive to additional recommendations made such as establishing a true MOA pool and no longer having MOAs assigned to individual physicians as well as move additional administrative tasks from physicians to MOAs. This support is critical for health system engineers to obtain in order to use simulation as a real problem-solving tool to provide healthcare decision-makers with the knowledge and insight to make appropriate decisions for improvement.