Analysis of Slot Allocation Strategies and their Impacts on Appointment Waiting Time in Context of Outpatient Clinics

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ABSTRACT

One prevailing problem in outpatient clinics with appointment systems in Singapore is that patients have to wait a long time for an available slot once they make requests. Such a long wait may negatively impact on the access to healthcare facilities, patient safety and satisfaction, etc. In recent years, such a problem is becoming worse due to the aging society and growing population. Besides the pressure of increasing demand, healthcare service providers in outpatient clinics are facing other challenges such as the complexity of patient request types, e.g., urgent or normal requests, requests for new or follow-up visit, etc. How to allocate the limited slots to meet the requirements of different requests is one of the performance measurements in outpatient clinics. In this paper, discrete event simulation is applied to study different slot allocation strategies and their impacts on waiting time. The dynamics between new visits and follow-up visits are analyzed as well.

Keywords: Appointment System, Appointment Waiting Time, Discrete Event Simulation, Outpatient Clinic, Slot Allocation

INTRODUCTION

Outpatient clinics are important components of a healthcare system. Other than emergency or inpatient department, outpatient clinics are devoted to diagnosis and treatment of ambulatory and non-emergency patients. Outpatient clinics can be classified into different categories by various criteria such as specialties (medicine, surgery, etc.) or operation mode (walk-in, appointment, etc.). In this paper, we focus on an outpatient clinic with an appointment system in a Singapore regional hospital. Patients make requests through the appointment system. A free time slot is assigned to each request. The slot allocation practice may follow various policies. For instance, first-come-first-serve policy will give the incoming request the earliest available time slot. Additionally, some time slots could be reserved for requests that need urgent attention. The capacity of an outpatient clinic is measured by the number of available time slots, which depends on many factors such as consultant workload, space constraint and target revenue.

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Outpatient clinics with an appointment system have several advantages over walk-in outpatient clinics. Firstly, demand fluctuation can be absorbed by the appointment system. Over-utilization or under-utilization is less likely to happen than in walk-in outpatient clinics. Secondly, appointment-based outpatient clinics provide a better patient experience than walk-in outpatient clinics. Patients are able to choose their preferred doctors and continue to see the same doctor for their follow-up visits in appointment-based outpatient clinics. Thirdly, patient waiting time of a well planned appointment based clinic is shorter because the uncertainty of patient arrivals is mitigated by the pre-defined time slots.

One important performance measure of an outpatient clinic is the waiting time. According to Gupta and Denton (2008), there are two types of waiting times in a typical outpatient clinic: indirect waiting time and direct waiting time. Indirect waiting time represents the period between a confirmed request and the assigned time slot. It is also known as appointment waiting time. Indirect waiting time is usually determined by the demand/supply relationship. A long indirect waiting time indicates a possible inaccessibility of healthcare facility and may cause higher no-show rate. Direct waiting time represents the physical waiting time a patient spends in the waiting area of the clinic. Long direct waiting time may affect patient satisfaction negatively.

There are many research works studying the waiting time problems in outpatient clinics. Most of them focus on how to reduce the direct waiting time by proposing different scheduling rules (Bailey, 1952; Cayirli & Veral, 2003; Ho & Lau, 1999) or identifying factors causing long direct waiting time (Chand et al., 2009). There are relatively few studies on the indirect waiting time problem in outpatient clinics. Such a problem can be considered as a demand/supply problem, where the demand is the appointment requests and the supply is the available slots. Several factors increase the complexity of the demand/supply problem. Firstly, variations exist at both demand and supply side. Such variations may cause temporary mismatch of demand and supply. Secondly, many outpatient clinics cater for patients with chronic diseases. Such patients are unlikely to be discharged after their first visits. Most of them will be followed up multiple times at the same clinic within a certain period. Hence part of the available slots has to be assigned to meet the need of follow-up visits. How to manage the dynamics between new visits and follow-up visits and make proper slot allocation is challenging to the healthcare service providers.

Discrete event simulation (DES) has been widely applied in healthcare system to test the what-if scenarios in different hospital sections including emergency department (Connelly & Bair, 2004; Su & Shih, 2003a), inpatient department (Cahill & Render, 1999; Costa et al., 2003; Kim et al., 1999; Ridge et al., 1998), and outpatient clinics (Hutzscheneuer, 2004; Cayirli, Veral, & Rosen, 2004, 2006; Su & Shih, 2003b; Wijewickrama, 2006; Zhu, Heng, & Teow, 2009; Klassen & Rohleder, 1996; Harper & Gamlin, 2003). A properly constructed and calibrated DES model provides a robust test field where the healthcare service providers are able to arbitrarily modify the current clinic settings or test certain process improvement to evaluate the corresponding consequences or effects. The simulation results of the DES model could also be a useful reference during the implementation phase.

Study in this paper is focused on indirect waiting time. Hence the waiting time of the rest part of the paper refers to indirect waiting time. A DES model is constructed to simulate the relationship between the appointment requests and available slots in the outpatient clinic. The impact of variations from both demand and supply sides on waiting time is studied. What-if scenario analysis is conduct to estimate the proper number of slots needed to meet a target waiting time. The complexity of the dynamics between new and follow-up visits is studied in this paper. Different slot allocation policies for new and follow-up visits are tested in the DES model. The interaction between the waiting times of new and follow-up visits is analyzed.
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