#3: October 2013

Have you ever spent an hour waiting for a ten-minute slot with your doctor? Surveys done last year revealed that visitors to a polyclinic spend up to 'several hours' at the facility[1].

The demand for medical care will increase as more Singaporeans grow older. This month, we turn our focus to solving crunches in clinic queue systems.

Mitigating Delays and Unfairness in Appointment Systems
By Therese Chan

Singapore has one of the best medical systems in Asia; the doctors are well-trained and professional, and the quality of medical care is relatively high. However, the stress on the medical system in Singapore is becoming rather pronounced. Appointments run over time and patients may wait for a long time for their consultations even though they arrive on time. Doctors may have to work overtime because of the poor schedule. A sequencing and scheduling solution based on robust optimization is able to mitigate the unpleasantness for the delays experienced by patients and doctors, and address fairness concern via balancing of service levels.

There are two stakeholders in this scenario: the patients and the doctors. The doctors wish to end their shifts on time. This scenario can be achieved by having all the patients for the day to arrive in the morning and having them to wait until their consultation time. However, clinics were not designed to handle so many patients at the same time, and this will make patients very unhappy with the hospital's service.

Upon their arrivals at the clinic, patients can wait for several hours before their consultation with the doctor[2]. From the viewpoint of the patients, it is best if their consultations start immediately after their arrival at the

clinic. This can be achieved by allocating each patient a generous consultation slot. However, this leads to an increased overhead cost and the doctors will have to stay beyond their shifts in order to finish all their consultations. Doctors will be dissatisfied over an extended period of time.

Several administrative solutions were implemented to minimise the amount of waiting time experienced by the patients. According to Dr Lew Yii Jen, the senior director of clinical services at the National Healthcare Group Polyclinics (NHGP), each patient at the NHGP clinics saved about 35 minutes of waiting time when the NHGP switched from a physical filing system for their medical case notes to E-notes (an electronic filing system launched in May 2009).[3] Despite this, patients in the public healthcare system are still unhappy with the disproportionate amount of waiting time in comparison to the length of the consultation session.

Professor Melvyn Sim and Ms Jin Qi from the Global Asia Institute[4] present their solution to this dilemma in the paper "Mitigating Delays and Unfairness in Appointment Systems"[5]. In this paper, they attempt to balance the two different goals of the hospital – to minimize the doctors' overtime hours and to minimize their patients' waiting time – with a solution based on the robust optimization theory. Robust optimization ensures that the solution will work even when all the information required to solve the problem is not available.

The authors study an appointment system where heterogeneous patients need to be sequenced and scheduled for consultation. They come up with the "Delay Unpleasantness Measure" (DUM) to measure the unpleasantness experienced by patients and doctors when their delays exceed acceptable thresholds.

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[1] Lynn Kan, "Patient satisfaction at restructured hospitals and polyclinics extends beyond medical care to administrative convenience," The Business Times, 27 March, 2013
[2] Ibid.

[3] Teh Shi Ning, "Polyclinics' coordinated system of patient care," The Business Times, 11 December, 2012
4 Prof Sim and Ms Qi are also from the Department of Decision Sciences, NUS Business School.
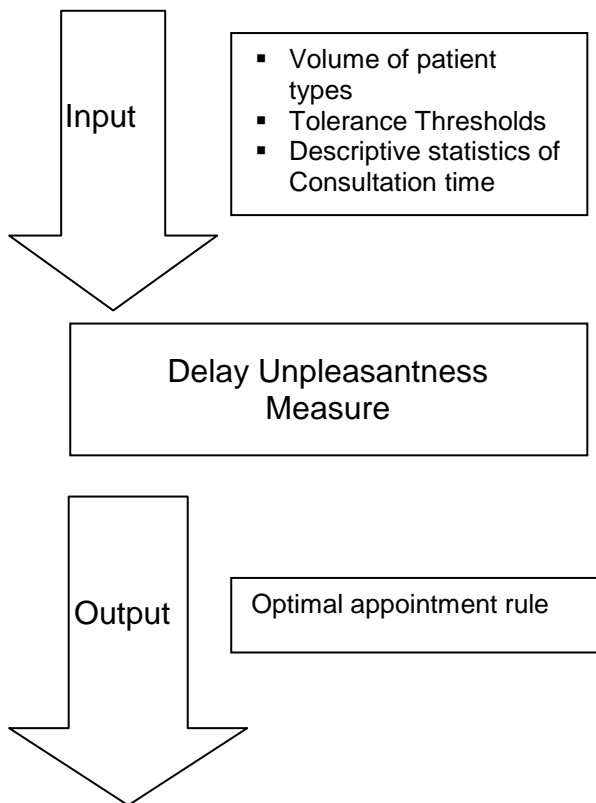5 This paper was submitted to Management Science and is currently pending review.

Figure 1: How DUM Works

The model considers various factors before allocating appointment slots for patients. For example, a patient on a follow-up visit is likely to deserve a shorter delay since he/she needs a relatively shorter consultation time compared to a new patient. Since the waiting time tends to progressively build up, the patient at the last position should be paid particular attention. To manage the number of uncertainties present, DUM assumes the following:

- Schedules have to be made before the commencement of the session
- Patients may be heterogeneous and are characterized by their service time distributions and tolerance thresholds
- Patients arrive on time
- Doctor starts the consultation promptly and the first patient experiences no delay.

In conclusion, Delay Unpleasantness Measure (DUM), a new quality measure designed by Qi and Sim describes an individual's satisfaction towards waiting at a clinic. The solution distributes wait times fairly to the patients and the doctors so nobody has to wait for a disproportionately long time.

The full paper can be downloaded here.