# IE3100 System Design Project
## Reducing Outpatient Waiting Time in Clinic B While Meeting the Bugeted Volume of Patients

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## Summary

This study focuses in Clinic B, one of the twenty specialist out-patient clinics situated in the National University Hospital (NUH). Diagnostic Imaging is excluded in our study.

This project aims to reduce the consultation waiting time and new appointment waiting time to fulfill the required key performance indicators (KPI) while meeting the budgeted volume numbers for patient load. The consultation waiting time is defined as the duration of time patients wait till seeing the doctor. Our team identified two main causes namely (1) Patient appointment scheduling and (2) Lack of man-power in certain prcedures.

We proposed solutions for these two probelms using simualtion on (1) Scheduling Methodology and (2) Increaseing staff capacity.

From the simulation results, rescheduling the appointment times proved to be a much more effective solution as it reduces waiting time most cost-effectively.

Flow-diagram of clinic B, there are these following procedures-
1. Registration
2. (X-ray)
3. Pre-consultation
4. Consultation
5. Post-consultation
6. Payment & collect medicine

This is the first step in understanding the system
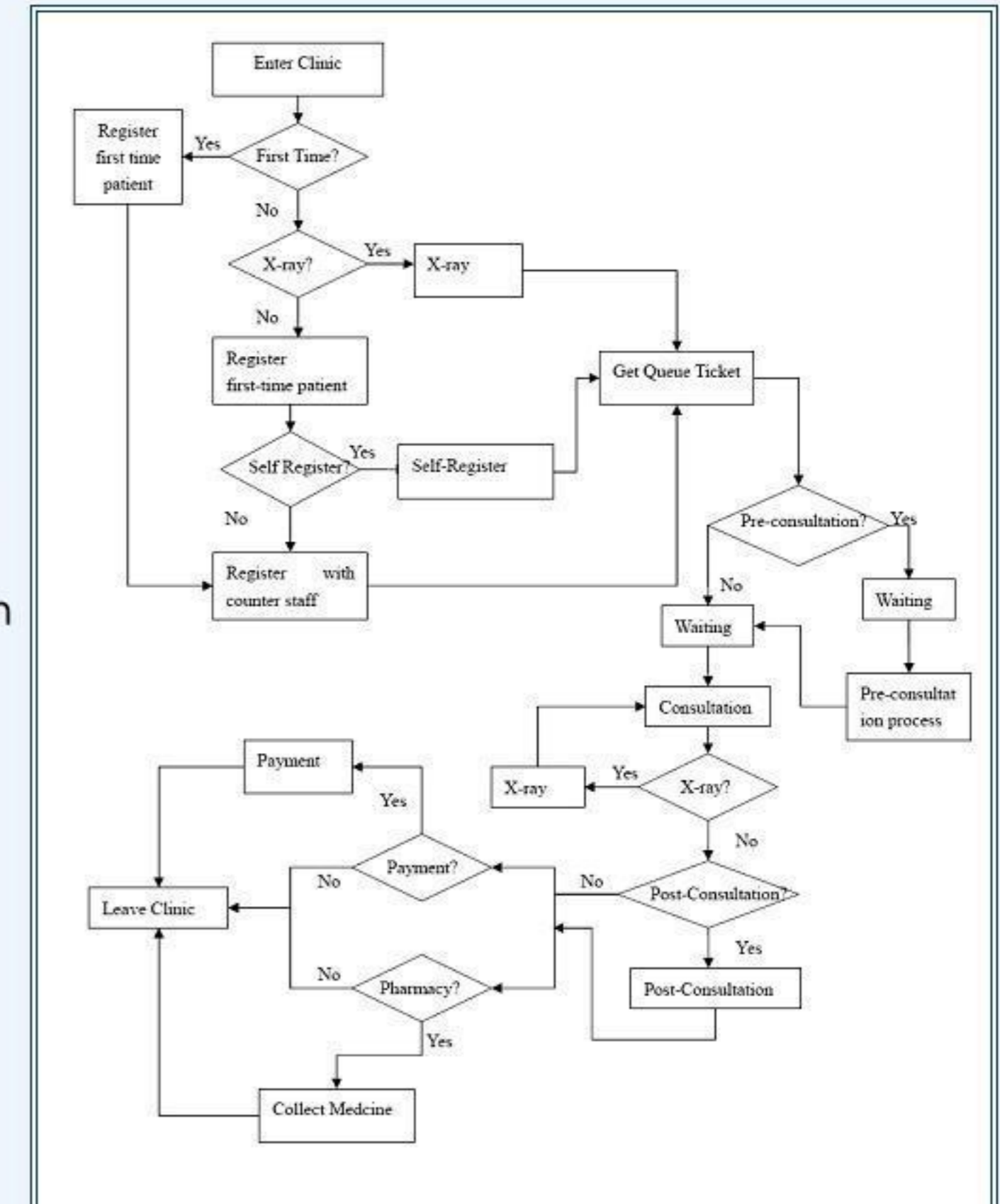


## Data Analysis

| Process Time | Mean | Standard Deviation | Fitted Distribution |
|---|---|---|---|
| Registration | 5 | 2 | Exponential |
| Pre-consultation | 24 | 15 | Gamma |
| Consultation | 14 | 10 | Normal |
| Post-consultation | 21 | 13 | Normal |
| Payment | 3 | 2 | Gamma |

*\* All figures in minutes*

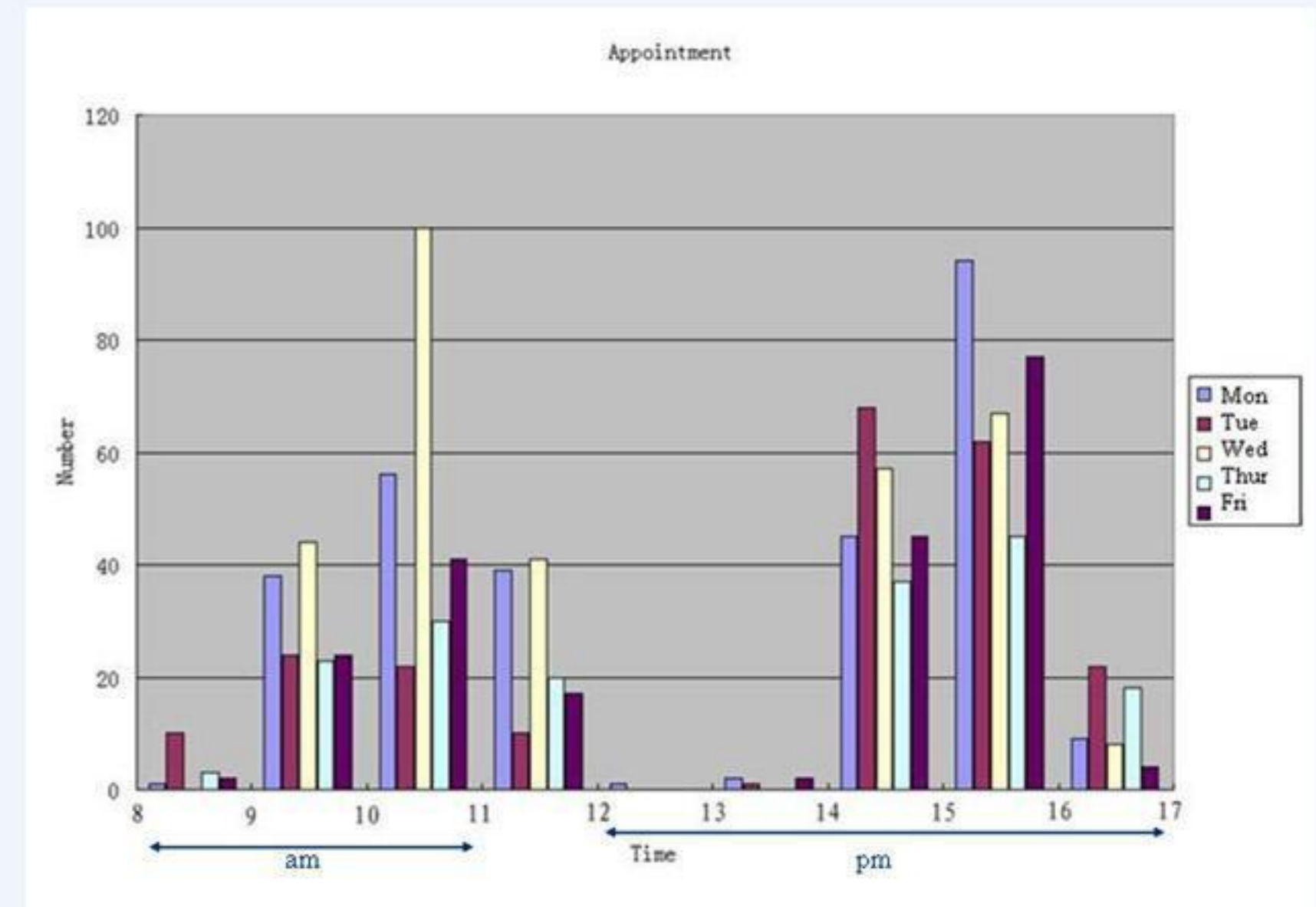The process time for each individual procedures and the distribution most closely fitted to them.

## Problem Analysts

| | Monday | Tuesday | Wednesday | Thursday | Friday | Total |
|---|---|---|---|---|---|---|
| Patient | 191 | 151 | 206 | 135 | 163 | 846 |
| Congested Appointment | 35 | 34 | 30 | 34 | 42 | 231 |
| Percentage | 0.20 | 0.25 | 0.26 | 0.33 | 0.35 | 0.27 |

**Congested Appointment: Appointments that are less than 2 minutes apart from the previous or the next appoinment, it can be viewed as a kind of "forced appointment".**



The graph of each day's appointment distribution. It peaks at around 10-11am and 3-4pm. It is an indicator that the appointments are often congested during the peak hours.

## Simulation Model Assumptions

1. Simulating, the day with the highest number of patients
2. Inter-arrival times of patients is deterministic
3. All patients will arrive before the appointment time
4. Patients who might arrive later than the appointment time, do not affect the system
5. No first time patients
6. No patients require X-ray services after entering the Clinic
7. Equal proportion of patients require Pre-consultation and Consultation directly
8. Patients will not consult doctor more than once per appointment

## Final Summary of Results

| | Current | Mod A | Mod B | Mod C | Mod D | Mod E | Mod F |
|---|---|---|---|---|---|---|---|
| Cycle Time | 94 | 55 | 58 | 59 | 38 | 57 | 61 |
| Registration | 7 | 4 | 4 | 4 | 3 | 6 | 4 |
| Pre-Consultation | 16 | 11 | 11 | 13 | 9 | 11 | 11 |
| Hand Consultation | 27 | 11 | 23 | 20 | 6 | 21 | 27 |
| Otho Consultation | 50 | 25 | 18 | 25 | 10 | 19 | 21 |
| Post-Consultation | 22 | 15 | 20 | 13 | 13 | 18 | 20 |
| Payment | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

*\* All figures in minutes*

ModA: Conjested appnts removed, ModB: Simple rescheduling, ModC:rescheduling+1more doctor+2 more post-consultations, ModD:Appnts interval 15 mins, ModE:ModB+1 more registration staff, ModF:ModB+more patients