



# Performance Assessment of Appointment System in Managing Outpatients' Waiting Time in a General Hospital: A Case Study

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## Abstract

**Background and Objectives:** Appointment scheduling system is a critical component in controlling patients' waiting time, so can increase the efficiency and timely access to health services. It is also an important determinant of patient satisfaction. The aim of this study was to assess the relationship of using a scheduling system and outpatients' waiting time in a general teaching hospital in Tehran, Iran.

**Methods:** This was a descriptive-analytical study performed cross-sectionally among outpatients referred to clinics of a non-teaching general hospital in Tehran in 2013. 3836 samples were selected from different stations. The sampling method was stratified randomized. Data were gathered by check lists. SPSS statistical software v. 24 was used for data analysis. In addition to descriptive measures, Mann-Whitney non-parametric test and Pearson correlation test were used for data analysis.

**Results:** The mean waiting time at admission was estimated 6.6 minutes. Analysing the waiting time of patients in admission indicated that walk-in patients wait more than scheduled patients for admission ( $P < 0.001$ ). Mean waiting time for physician visit was 75.7 minutes. Analysing the differences of waiting time of scheduled and walk-in patients for visit show their waiting time were not different ( $P = 0.206$ ).

**Conclusion:** The studied appointment system was successful in controlling patient arrival but failed to control waiting time for physicians visit. It seems that considering physician arrival schedules will be helpful for designing appointment system and reducing outpatients' waiting time.

**Keywords:** Outpatient, Appointment system, Scheduling, Waiting time, Non-teaching hospital

## Background

In recent decades, outpatients' services, as a part of health system, are changing for that the number, variety and severity of diseases of outpatients have increased.<sup>1,2</sup> This condition denotes the importance of outpatient referral management for increasing the efficiency of outpatient settings.<sup>3,4</sup>

Appointment scheduling system is a critical component in controlling patients' waiting time and for utilizing the health services timely.<sup>5</sup> These systems mainly work to regulate the patients' demand for various services<sup>6,7</sup> and help to reduce the variability in patients' arrival process.<sup>6</sup> This system can control both direct and indirect waiting time for patients,<sup>8</sup> thus, useful for uniform distribution of workload during working hours.<sup>9</sup>

Outpatient scheduling in health care has been

researched extensively over the last 50 years.<sup>10</sup> Baily presented the first outpatient scheduling model for designing patients' arrivals in 1952. Baily was a pioneer in studying individual block system and combined single block and individual block scheduling. His study was performed in the circumstances that usually all patient arrive the clinics in the same time. The most primitive form of outpatient scheduling is single block scheduling. The single block rule assigns all patients to arrive at the same time. The patients are served on a first come first serve basis. Another, nowadays more common, form of appointment scheduling is the individual block rule. Patients are assigned unique appointment times that are spaced throughout the clinical session. Bailey used a Monte Carlo simulation technique to find the number of patients to assign an appointment at the beginning of the session and the length of the intervals between the remaining appointment times. This valuable study paved the way for future research.<sup>11</sup>

Gradually, with increasing the complexity of service delivery systems, more variables were considered in the

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model. To model outpatient queuing system a considerable number of studies used simulation techniques.<sup>12,13</sup> One of the advantages of simulation modelling over analytical approaches is the ability to model complex outpatient queuing systems and to represent environmental variables.<sup>14,15</sup> Simulation experiments are conducted to evaluate the performance of the system and to understand the relationship between various performance measures and various environmental factors. These factors are various and can be categorized in three groups: system characteristics, care receivers' characteristics and service providing policies.<sup>16</sup>

The aim of this study was to assess the relationship of using scheduling and outpatient waiting time in a general hospital in Tehran, Iran.

## Methods

This was a descriptive-analytical study done cross-sectionally in 2013. The study population was outpatients referred to the clinics of a non-teaching general hospital in Tehran, the largest general hospital providing health services to social security insured patients. A large variety of outpatient services were provided in this hospital. Insured demands for using the services of this hospital were very high. Patients were admitted in clinics in 2 forms: scheduled and walk in. A total of 3836 samples were selected from different stations; 336 samples from admission departments and 3500 samples from all 14 specialty clinics (250 samples in each clinic). The studied clinics were: internal medicine, general surgery, obstetrics and gynaecology, cardiology, infectious disease, orthopaedic, urology, ear nose and throat, dermatology,

ophthalmology, psychology, neurology, neurosurgery and anaesthesiology. The sampling method was stratified randomized method in different stations of service delivery process.

Data gathered by check lists that was made by researchers by considering the aim of the study and outpatient workflow at the setting. The check list included two parts: first part had 15 demographic and general questions and the second part contained 12 questions that record patients' workflow and time. To consider the moral issues, patients who were willing, were participated in the study and checklist did not have any identity information that led to the identification of patients. The content validity of check lists was proved by experts and hospital authorized. Data gathering phase was done by 5 trained experts during 4 months. SPSS v. 24 was used for data entry and analysis. In addition to descriptive measures, Mann-Whitney non-parametric test and Pearson correlation test were used for data analysis. Significant level was considered  $< 0.05$

## Results

The mean (SD) age of the respondents was  $43.2 \pm 19.9$  years. Most samples were female (63.4%), married (78.6%), had diploma (31.7%) and lived in Tehran (72.5%). Most of the respondents were household (45.5%) and retired (15.5%). Other job categories had lower frequency (Table 1).

Test of normality for waiting time variable indicated that it was not normally distributed so non-parametric tests were used for data analysis. The mean waiting time at admission estimated  $6.6 \pm 7.6$  minutes and the median

**Table 1.** Frequency Distribution of Demographic Characteristics of Respondents

Variable		Frequency	Valid Percent
Sex	Female	2219	63.4
	Male	1281	36.6
Marriage statues	Single	532	15.2
	Married	2751	78.6
	Other	217	6.2
Education	Illiterate	644	18.4
	Elementary	780	22.3
	High school	536	15.3
	Diploma	1110	31.8
Location	University	423	12.2
	Tehran city	2537	45.3
	Tehran province	543	15.5
Job situation	Other provinces	212	6.1
	Household	1586	45.3
	Retired	543	15.5
	Student	212	6.1
	Employee	324	9.3
	Self-employment	461	13.2
	Unemployed	234	6.7
Others	140	4.0	

was 4 minutes. The minimum and maximum waiting times at admission were 0 and 37 minutes, respectively. Patients were admitted in different counters that had different waiting times. Analysing the waiting time of these 2 groups indicated that walk-in patients waited more than scheduled patients for admission ( $< 0.001$ ) (Table 2). The patients' arrival time was negatively related to their waiting time for admission ( $P=0.003$ ); thus, the correlation was significant just for walk-in patients ( $< 0.001$ ) (Table 3). Waiting time for physician visit was estimated and tested for normality. The results showed that this variable was not normally distributed. The mean waiting time in this station was  $75.7 \pm 54.9$  minutes and the median was 65 minutes. Dividing patient into walk-in and scheduled and analysing the differences showed that this factor had no relation with waiting time for outpatient visit ( $P=0.206$ ) (Table 4).

### Ethical Statement

The study was approved in the hospital ethics committee.

### Discussion

Health service providers struggle to balance supply and demand. Appointment systems help them by smoothing work flow, reducing crowding in waiting rooms and allowing health systems to honour patient and providers while matching supply and demand.<sup>8,17</sup>

The study finding indicated that the hospital scheduling system was successful in controlling admission waiting time. Different studies mentioned that a well-designed scheduling system will decrease waiting time by regulating

patient flow. A well-designed appointment system is defined as a system that considers unscheduled patients with no changes in waiting time of scheduled patients. The aim of such appointment system is to provide timely and acceptable access to health services for both scheduled and unscheduled patients.<sup>9,14-16,18</sup>

Scheduling systems are used in different parts of health system. These parts could include all levels of health providing system from primary to inpatient cares.<sup>8</sup> It seems that appointment system in studied hospital was effective in controlling patients' arrival by considering the admission working hours. Moreover, scheduling system was effective in smoothing patients' arrival by eliminating the correlation between arrival time and waiting time. Many factors affect the performance of appointment systems including arrival and service time variability, patient and provider preferences, available information technology and the experience level of the scheduling staff.<sup>8</sup>

Studying patients' flow in other stations especially visit room show that patients' waiting time in this station was not affected by performance of scheduling system. It seems that some factors were ignored in designing of system related to visit room such as physicians' arrival time, physicians' arrival distribution and the duration of their presences at the clinic. By the way, patients' arrival time was designing by considering admission department working hour not clinics working hour. A well designed appointment system should consider the process of services providing by resources. This is very important for more complex systems such as hospitals and multi-

**Table 2.** Comparing Outpatients Waiting Time for Admission in Different Type of Admission

Admission Type	Frequency	Valid Percent	Mean Waiting Time (min)	Mean Ranks	P Value
Scheduled	290	86.3	5.7	157.5	
Walk- in	46	13.7	12.9	237.6	<0.001
Total	336	100.0	6.6	-	

**Table 3.** Correlation of Outpatients' Waiting Time for Admission in Different Type of Admission With Patients' Arrival Time

Admission Type	Frequency	Mean Waiting Time (min)	Spearman Correlation Coefficient	P Value
Scheduled	290	5.7	-0.050	0.398
Walk-in	46	12.9	-0.832	<0.001
Total	336	6.6	-0.138	0.003

**Table 4.** Comparing Outpatients Waiting Time in the Clinics in Different Type of Admission

Admission Type	Frequency	Valid Percent	Mean Waiting Time (min)	Mean Ranks	P Value
Scheduled	1204	34.4	77.6	1635.5	
Walk- in	2296	56.6	74.7	1591.9	0.206
Total	3500	100.0	75.7	-	

disciplinary clinics as our studied case.<sup>15</sup>

For improving the present scheduling system, some new factors should be considered in renewing the system such as physicians' arrival time and their delay. These factors should be considered for different clinics individually. This modification will help to increase a hospital efficiency by improving resource utilization and patients' satisfaction.<sup>19</sup>

However, appointment schedules do not resolve all the uncertainties in daily demand such as high rate of no shows and cancellation.<sup>20</sup>

### Conclusion

Health service providers struggle to balance supply and demand. Appointment systems help them by matching supply and demand. These systems should be designed by considering three important groups of factors including system characteristics, care receiver's characteristics and service providing policies. Ignoring each part has some complications. Considering important factors in designing appointment system will considerably improve its performance. However, there are some uncertainties in daily demand such as high rate of no shows and cancellations that provide new challenges for system designers. So, considering predictable factors in system will help to manage uncertainties more efficiently.

This study indicated that for improving the present scheduling system, some important factors should be considered in addition to patient arrival distribution, such as physicians' arrival time and their delay. It seems that these factors should be considered for different clinics individually. This modification will help to increase hospital efficiency by improving resource utilization and patients' satisfaction.

### Authors' Contributions

AA made substantial contributions to design, analysis and interpretation of data; and also drafting the manuscript. FF contributed to designing the study and reviewing the manuscript. FM contributed to designing the study, interpretation of data and drafting the manuscript. HY had participated in acquisition of data and final approval of the manuscript to be published.

### Competing Interests

The authors declare that there was no conflict of interest.

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