

# A Case Study Analysis of Outpatient Department Waiting in Noida based Hospital

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**Abstract :** Healthcare industry is experiencing pressure to improve the accessibility of the services to all patients equally and concurrently considerably reducing the cost of service offered maintaining the quality of care delivery. Patients have been regularly facing problems like long waiting times, service delays, and queuing. To improve the health care system, it is necessary to develop complete understanding of the health care delivery system to be able to find bottlenecks and in what scenarios do the system face failures as patients get introduced in the system. This study allows the hospital to notice what can show impact on improvement in hospital performance and what factors can help in reducing the patient waiting time. A cross-sectional study of a sample of 548 outpatients was conducted in a Gautam Buddha Nagar Hospital for one month duration to study the overall waiting time and factors responsible for the system congestion, using time and motion tool along with a structured questionnaire. It was highlighted through the linear regression model that the outpatient department gets congested mainly on specific weekdays and timings, patient's age and length of the queue due to increased outpatient footfall in an unplanned manner. The overall waiting time was found to be increasing by 13.4minutes (age above 50yrs), 2.7minutes (Monday, Wednesday & Saturday) and 4.3minutes (morning OPD hours) with each additional patient in the queue. Implementation of patient scheduling system has been suggested for smoothening out the overall process in outpatient department and other related departments in the hospital. The research was limited to the study of overall waiting time as an effect of socio-demographic and post-visit factors related to the outpatient department.

**IndexTerms - Waiting, Outpatient, Scheduling, Appointment, Hospital.**

## I. INTRODUCTION

Queues are pervasive. We encounter waiting in a line every day, from driving to work to checking out at the supermarket, or at factories in which jobs are in waiting on different machines which wait for their turn for being overhauled. Even in emergency departments, a doctor's appointment, banks, ATMs, Rail Reservation Counters are few examples of waiting in a queue which happens to almost everyone while seeking medical help. It's often very frustrating to wait for long particularly before seeing the doctor.

Healthcare industry is experiencing pressure to improve the accessibility of the services to all patients equally and concurrently considerably reducing the cost of services offered maintaining the quality of care delivery. Healthcare institutions have been regularly facing problems like long waiting times, service delays, and queuing (Zeithaml, Parasuraman & Berry et al., 1985).

The growth in economy has led to complete restructuring of the health care services delivery system which has brought about several changes in the entire health care system. This has resulted in a shift in the entire hospital management philosophy. Earlier, the objective of hospitals was to emphasize on bed occupancy rate, increased admissions and elevate the no. of cases load. However, this has grown into a demand of raising health care standard which refers to make the health care delivery system cost effective and efficient too. This would mean that the patient has to be treated in a manner that he moves out of the hospital quickly too. Patients are nowadays more informed and aware in our growing economy. This genuinely demands for health care system which is cost effective and with upgraded service quality, as highlighted by the researchers Salleh, Yusof and Ali et al. (2005).

Nowadays in health care, patients consider Comprehensiveness as the actual criteria for suitable and desirable treatment i.e. a treatment which is rapid and most suitable. Prompt treatment in a hospital means to minimize the time for getting a health service with an emphasis on the favourable treatment (Dansky & Miles et. al. 1997). The **Comprehensive Care Center** has an expert team of healthcare professionals from different disciplines whose main goal is to provide specialized care to the patients, with excellence. This comprehensive centre services include almost all types of medical treatment and follow-up care for patients starting from birth; all types of surgeries, its consultations and treatment; psychology and counseling, prenatal testing, and nutrition advice. The patients who need an overall support or who wish to get services at single place to save on time and resources come to such comprehensive centers, as there is collective availability of doctors. This leads to excessive pressure on the system overall and results in the formation of queues. When the demand at service points in these hospitals is greater than the capacity, bottlenecks result which hinder optimal utilization of other service delivery points creating an idle capacity. The overall effect is an increase in patient waiting time and a back log in service delivery resulting in queue formation, although the patients are not interested in waiting in queues.

There are numerous factors—physical, psychological, and emotional, to name a few—that affect a customer's perception of the waiting experience. The patients now look for health care centers that have advanced facilities to match their requirement and desirable treatment. Also, this treatment should be rapid and prompt with better service quality. It means that the hospitals need to function so that the most favourable treatment or a health service is provided in the minimal time (Dansky and Miles et al., 1997).

Waiting imposes unnecessary suffering for patients having adverse on the medical outcomes creating further complications in patients condition which results in added healthcare costs and compromised efficiency. To improve the health care system, it is necessary to develop a complete understanding of the health care delivery system to be able to find bottlenecks and in what scenarios do the system face failures as patients get introduced in the system. Also, by developing an understanding of the co-

ordination and flow of patients, doctors and other resources within the support system, the overall lag could be pointed out and improved upon within different departments of the health centre (Hall et al. 2006 as cited by Kim et. al., 2014).

Practical issues such as the ease of use of appointment system, or implications on modifying physicians' behaviour can be considered as well, in order to achieve the ultimate goal of improving the overall system. Effectively managing patient flow in an outpatient unit in a large hospital is a key to achieving operational excellence as well as ensuring clinical quality, as it handles enough volume of patients with a diverse case mix.

There is a need for more realistic representation of outpatient departments, as patient waiting time and waiting-room congestion due to triage are two of the few tangible quality elements. Well-designed appointment systems have the potential to increase the utilization of expensive personnel and equipment-based medical resources as well as reducing waiting times for patients[2]. Hospital managers should therefore take steps to improve quality in these three aspects; appointment system, patient flow and capacity. The fact is many patients going to public hospitals prefer to move to private hospital to get medical check-ups and treatment.

### Service Operation in Healthcare Industry

Healthcare service is a patient-oriented service that requires continuous interaction with customers. It utilizes facilities and equipment, and consumes a large volume of nursing care. Therefore, it becomes increasingly important for healthcare executives to understand what kind of facility, equipment, and workforce decisions are critical to achieve the commonly acknowledged goal of providing quality health service at a reasonable cost as per researcher Li, Benton and Long et. al. (2002).

Healthcare management has evolved into a dynamic and complex field. This diverse industry is always changing due to scientific discoveries that bring significant contributions to improve the health standards of our communities. The changes have moved on to determine new ways about how and where healthcare is provided. Li, Benton and Long et. al. (2002). *et al.* found that the obvious differences in previous hospital research and current hospital practice in managing demand is that previous research tends to focus on a reactive approach to manage demand through internal improvement of facility utilization and better scheduling policies.

Integrated Healthcare Management is the systematic application of processes and shared information to optimize the coordination of benefits and care for the healthcare consumer. Integration of healthcare management not only observes the relationship between customer (patients) and hospitals but also the inter-relationship between departments in the healthcare systems. This integrated management will support the effectiveness and efficiency of hospital. Hospital strategic planning can be performed at the corporate level by examining the hospital "system" which would include hospitals, HMOs, walk-in clinics, and other health-oriented businesses (Butler, Leong & Everett et. al., 1996).

### Outpatient Management

Outpatient services are an essential component in healthcare. The development of technology and the rapid increase in population, has led to fulfill an objective of developing an outpatient scheduling and appointment system. For this a particular measure of performance is optimized in a clinical environment through an application of resource scheduling under uncertainty. The researchers, Cayirli and Veral et. al., (2008) and Mardiah and Basri (2013) have shown the model of a clinic environment in Figure 1. The underlying problem applies to a wide variety of environments, such as general practice patient scheduling, scheduling patients for diagnostics, surgical scheduling, etc. In all scenarios patients face the problem of queues.

### Queuing Theory

Queuing is an event where people or goods undergo a process, starting from the arrival queue; enter the system queue, wait until the last service is done forming a queue. Length of the queue can be limited and can also be unlimited, depending on the number of existing units in the system. Waiting line or queuing system is an item or people in a line, awaiting service. The parts of a waiting line are: (a) Arrivals or inputs to the system: these have characteristic such as population size, behaviour, and statistical distribution. (b) Queuing discipline or waiting line itself: Characteristic of the queue include whether it is limited or unlimited in length and the discipline of people or items in it, for example FIFO. (c) The service facility: its characteristic includes its design and the statistical distribution of service time. There are four type of queuing model, which are single channel single phase system, single channel multiphase system; multiple channel single phase system and multiple channel multiple phase systems (Heizer and Render et. al., 2008).

### Factor That Influenced Outpatient Management

The two factors that mainly influence the outpatients management are the Appointment System followed and the patient flow within the system. Both have been discussed further.

**Appointment System** The term of "appointment" refer to the period of time allocated in the schedule to a particular patient's visit and "service time" refer to the amount of time the physician actually spends with the patient (which may be shorter or longer than the appointment duration) (White, Craig and Klassen et. al., 2011). Based on Cayirli and Veral et. al. (2008), appointment scheduling can be classified into two broad categories:

**Static.** All decisions must be made prior to the beginning of a clinic session, which is the most common appointment system in healthcare

**Dynamic.** The schedule of future arrivals are revised continuously over the course of the day based on the current state of the system. This is applicable when patient arrivals to the service area can be regulated dynamically, which generally involves patients already admitted to a hospital or clinic. The most primitive form of outpatient management 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.

Manager should consider the factor that influenced on design appointment system. Figure 2 describes factors that influence the design of an appointment system (Mardiah and Basri et al. 2013).

**Patient Flow:** One of the major elements in improving efficiency in the delivery of healthcare services is patient flow. From a clinical perspective, patient flow represents the progression of a patient's health status. Patient flow management requires addressing three aspects of an outpatient unit: arrival of patients, service process, and queuing process. Working on the patient's arrival includes controlling its patient panel size, balancing patient volumes across available sessions, and achieving desirable patient arrival pattern within a session as stated by the researchers Yeon, Lee and Jang et al. (2008). Based on study by Cote et al. (2000), Patient flow can be described by one of two complementary approaches: clinical or operational. Regardless of approach, all patient flows share four common characteristics: an entrance, an exit and the random nature of the healthcare elements. In an outpatient application of a family practice clinic's patient-care service requires enough resource planning, scheduling, and utilization of available resources as shown in Figure 3 (Panaviwat et al. 2014). Patient Flows get affected due to even a single factor. Quantitative tools, like forecasting and queuing models, can help decision makers assess healthcare services in light of the patient flows. Queuing performance measures such as time in the system and traffic intensity have direct correspondence to the patient flow characteristics.

This study allows the hospital to notice what can show impact on improvement in hospital performance. Moreover, this study will show what factors can be improved in reducing the patient waiting time. Research question for this paper are: • What is the arrival pattern of patient in Gautam Buddha Nagar hospitals? • What factors are causing high outpatient waiting times? The objective of this paper is to investigate the factors responsible for outpatients' waiting and actual patient waiting time in Gautam Buddha Nagar based Hospital.

## II. RESEARCH METHODOLOGY

### 2.1. Research Paradigm

The research is done by using the empirical observation made cautiously. Research methodology used in this research is case study. Case study is research that is an in-depth examination of an extensive amount of information about very few units or cases for one period or across multiple periods of time. (Neuman et al., 2006).

### 2.2. Study area

This study was carried out in a hospital of Gautam Buddha Nagar District, at the general outpatient department. It is a hospital with bed capacity of 100 beds, admits an annual average inpatient of about 5000 and attends to over 35000 outpatients. This hospital has 10 specialties i.e. Obstetrics and gynecology, dermatology, ENT, Nephrology, Ophthalmology, Paediatrics, Pulmonary, Neurology, Urology. The hospital provides complete medical services of these specialties i.e. out-patient services, surgical services, diagnostics and medicinal services. This study only concentrated in the out-patient department of the hospital.

### 2.3. Study population

The study population included all the patients reaching out to hospital at the outpatient department throughout the day during OPD hour.

i. Patients arrival was FCFS. Only Walk-in patients were there. No arrangement of pre-appointments existed. And the patients' service time and waiting time both had a complete disconnect with the actual patients arrival time. There was no patient bifurcation in terms of age, illness or any other parameter for patient categorization or preference in service delivery. The patients had to be waiting for the service required for variable time. This moved the researcher to conduct a research in this direction, to find the impact of this practice on the patients.

ii. The study carried out in this hospital was a cross-sectional study. The researcher conducted a cross-sectional survey study to measure the actual patient waiting time. During this study, some of the factors were also identified that contribute to the total time patients spend in the hospital's outpatient department for the healthcare service, in order to find detailed information about the quality of service delivery.

### 2.4. Sample selection

The sample of patients was picked by the method of systematic random sampling, amongst all patients who visited the outpatient department during the survey.

### 2.5. Sampling procedure

The registration desk nurse states that on an average 100 patients register in the hospital outpatient department each day. Total 10 Research assistants were employed during the research seeing the extensive inter-departmental patient movement. So the patients are continuously followed by the research assistant everywhere for noting down the patient experience, starting from 9:00am.

Each research assistant would follow 1 patient per day making the daily required sample size is 10 patients by 10 research assistants in one day.

Daily Sampling frame = 100 = every 10th patient  
Daily sample size = 10

Every 10<sup>th</sup> patient arriving in OPD, was marked, starting from 9:00am and was requested to join the study. A trained research assistant was assigned to the patient, once they consented for participation, to watch and record the time that the target patient spends in each section of the hospital until they finally exit the hospital.

The hospital OPD department opened at 9:00am and closed at 10:00pm with peak hours between 10:00am to 2:00pm and 5:00pm to 9:00pm. Therefore sampling was done in two phases i.e. 5 patients in the morning (10:00am-2:00pm) and 5 patients in the evening (5:00pm to 9:00pm) as the total number of patients expected to participate is 10 patients each day for a month.

## 2.6. Theoretical Framework

### 2.6.1. Dependent Variables

In this study, the dependent variable is the overall waiting time of patients. Waiting time is a continuous variable and is measured as the total and all sections average waiting time.

Total average waiting time is measured as a continuous variable which is obtained by taking all sections waiting times together. This dependent variable illustrates the overall waiting time i.e. the extent to which a patient waits overall.

### 2.6.2. Independent Variables

The Independent variables include the primary explanatory variables which are the socio-demographics factors and the clinical factors such as age, gender, place of residence, education level, employment status and location, illness and its severity and nature of diagnoses. The illness and its severity will help the nursing staff to understand the triage scenario. Also, the nature of diagnoses helps in grouping and directing the patients to major diagnostic illness section. Other independent variables include patient referrals, if any (i.e. referral from public hospital or private hospital), arrival day/date and time, and length of the queue. The information on each of these was collected during the data collection survey. This data was further used to measure the influence of each of the independent variables on the dependent variable.

## 2.7. Data collection

### 2.7.1 General data collection

Data collection was done with patients. The actual time spent was measured for each patient followed by the exit interview of the patient as soon as the purpose of the visit to outpatient department was complete.

The time spent in the outpatient department was divided into two parts; service time and waiting time. Service time is the duration of time a patient spends in contact with a healthcare official and waiting time is the time a patient was waiting to be attended.

### 2.7.2 Collection tools

Majorly, there were two data collection methods used in this study.

The first tool is time and motion, measured using a stop watch, to monitor the patient flow from the time the patient entered, went to various sections, and finally departed from the outpatient department.

The second tool is the structured questionnaire, which was administered by the researcher.

Excluding the patient is an emergency case or special case category, all patients were directed to the registration desk from the helpdesk, for the registration purpose. Each patient is registered on the basis of first come first serve discipline.

After registration, the patient needs to pay fee and is given a unique number. Thereafter, patients are asked to wait till the nurse would call them to see the doctor based on their unique number. Also, the nurse also checks for triage in the waiting patients. In case of any patient with severe illness, such patient is called accordingly into the doctors' lobby. In this way, the patients further queue up in the holding room and enter the examination rooms as soon as they are asked by the nurse.

After examination, if the doctor requests for any diagnostic investigation from the laboratory, X-ray etc. the patient follows the same process and then queues up in the laboratory or diagnostics, to receive the prescribed test/s and reach out to the doctor again once the reports are handy. While the tests are complete, patients with diagnostic reports do not need further waiting in queue. They could enter the doctor's cabin with the next patient. Based on the diagnosis, a patient is given a prescription to get medicines from the pharmacy. The patient is either advised to be admitted in the hospital due to the prevailing condition or he is sent from the OPD department with medicine prescribed for some specific period and schedule for next visit to the doctor for further examination.

At any point when the patient is about to leave from Outpatient department a short exit interview was administered in English or Hindi for those who did not understand English. These exit interviews captured the socio-demographics.



### 2.7.3 Quantitative data

Each day, in the end, all filled up forms were checked for clarity, completeness, consistency of information. Any recorded mistakes were corrected. All variables data including the ones with missing information were entered using SPSS software.

Variables that were recorded are; Place of residence, Disease diagnosed, reason of delay and service satisfaction.

About 36 patient responses had missing results in some variables. These responses were marked and deleted list-wise.

A total of 548 patient records were entered after compensating for missing data or fall outs during follow ups.

### 2.7.4 Research Objectives

**Objective 1:** To find the median overall waiting time, which was the service time and waiting time i.e. when patient was waiting to see the health expert.

**Objective 2:** For time taken by the patients during the outpatient department visit, to move through each section, the researcher calculated the Median and inter-quartile rang for each level.

**Objective 3: Test for Normality:** To check the Normality of the empirical data through Hypothesis Testing.

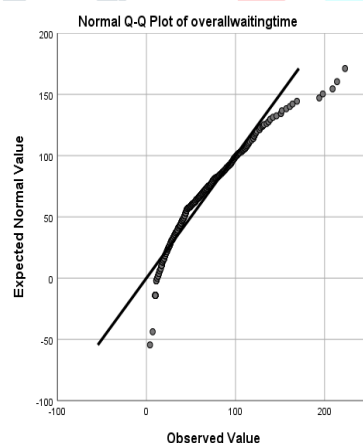
**Objective 4:** To conduct Multivariate analysis showing the socio-demographic and other characteristics' frequencies and percentages with sub-categories being analyzed separately to ensure no miss out in detailing.

## III. DATA ANALYSIS

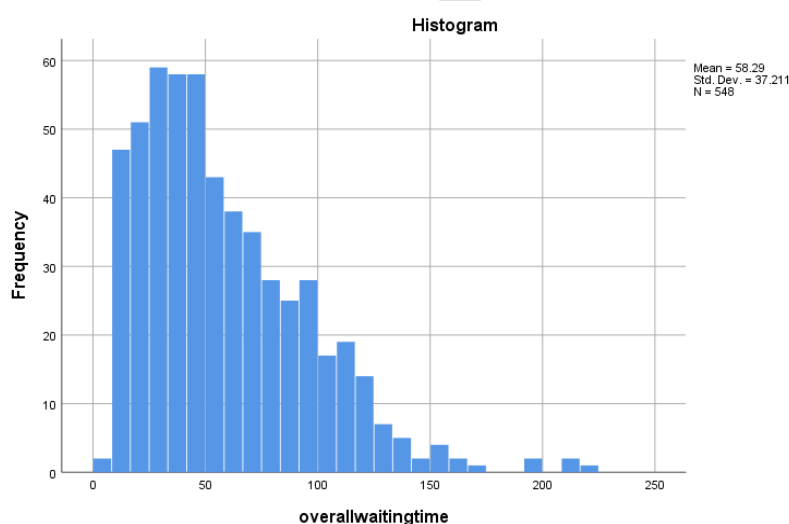
To prepare the data ready for analysis, data related to Time and motion was entered into Excel sheets. The data related to patients and outpatient department was transferred to SPSS.

**3.1. Normality Test:** The empirical data was fed in the SPSS software for analysis and was coded and recoded to match the software requirement.

Further the empirical readings of overall waiting time were tested graphically by plotting on a Q-Q plot graph along with the Histogram.



**Figure 1a:** Normal Distribution Curve of Overall Waiting Time



**Figure 1b:** Histogram of Overall Waiting Time

The Normal probability plot graph of overall waiting time looks fairly straight, covering the majority of points plotted. The Histogram plotted for the overall also looks fairly symmetric and unimodal.

Based on these observations, we can assume that our dependent variable, overall waiting time follows a normal distribution. This satisfies the assumption for using linear regression.

### 3.2. Multivariate analysis

The socio-demographic and other characteristics were tabulated to show their frequencies and percentages with sub-categories being analyzed separately to ensure no miss out in detailing.

Majority of patients (73.5%) come from Noida and remaining from other areas mostly from Greater Noida. The analysis of socio-demographic characteristics, and post visit characteristics i.e. patients experience as they went through the outpatient department was noted.

Since the outcome variable (overall waiting time) was continuous, the multivariate analysis was done by using simple linear regression to evaluate the associations between the outcome variable (overall waiting time) and each patient demographic and OPD departmental characteristics. The alpha( $\alpha$ ) of 0.05% ( $p < 0.05$ ) was used to perform Multivariate analysis.

At multivariate level, all the variables were fed into a linear regression model since time followed a normal distribution (figure 5a). The variables with p-values greater than 0.05 were removed in a descending order in a step-wise manner until only the model included only those variables in which the dependent variable i.e overall mean waiting time showed statistically significant relation with its reference independent variable.

The final linear regression model included the variables age, weekday/s, time of arrival. Length of the queue, was included in the model later on as it could impact the model whenever no. of patients increase in the system overall.

## IV. RESULTS AND DISCUSSION

The results related to the actual patient waiting time and service time and the main factors that lead to bottlenecks and increase the total time patients spend in the outpatient department were identified.

### 4.1. Socio and Demographic Characteristics of the Patients:

Overall there was a footfall of 1600 patients including all specialties, with maximum footfall on Monday, Wednesday and Saturday. Morning hours of OPD department are observed as crowded, usually during 10:30am – 1:30pm with an average footfall of 37 patients.

Of all the 1600 patients, 584 patients were found to have visited the hospital during these hours and also went through the process of registration, triage, doctors' consultation followed by clinical examinations and pharmacy. 50 patients went for X-ray or USG scan, 104 patients went to laboratory testing and 430 through the pharmacy of the hospital. 6.14% patients were non-responsive amongst 584 patients. Therefore, about 36 patients out of these 584 patients did not agree to participate in the study conducted due to their reasons of shortage of time and disinterest. Table No. 1 shows the basic characteristics of the respondents.

The socio demographic details of the respondents have been noted through the survey. 65% of the patients were females and 30% were adults aged between 29 to 49 years and 58% of the total patients were married as per our categorization. About 59% patients came from Noida and nearly 41% came from nearby areas. Out of all, 38% patients were employed.

Patient Characteristics	Frequency	%
<b>Age</b>		
<15 years	58	10.6
15-29	126	23
29-50	164	30
51-80	182	33.2
>80	18	3.2
<b>Gender</b>		
Male	192	35
Female	356	65
<b>Residence</b>		
Noida	323	59
Outside Noida	225	41
<b>Service</b>		
Employment	210	38
Unemployed	338	62
<b>Marital Status</b>		
Single	88	16
Married	318	58
Divorce	15	2.7

Table 1: Socio-demographic characteristics of respondent OPD patients

#### 4.2 Facility related to characteristics of the patient:

As per the patients' statistics given in Table 2, only 4.2% patients arrived before 10am. However, it increased to 23% by 12noon. Also, the maximum no. of patients' footfall was recorded on Mondays in the OPD department, recorded as 24.6%. Patients quoted the main delay point were at Chemist shop and Examination at 42.9%. However, the main reason quoted for delay in examination and all processes was due to many patients to be handled in a short duration. The figures were recorded as 44.7%.

The main health problem was due to Fever, as 24% of dengue fever cases were recorded, followed by 12.8% of Malaria / Viral Fever.

VISIT CHARACTERISTICS	Frequency	%
<b>Arrival time</b>		
9-10am	23	4.2
10-11am	139	25.4
11-12pm	156	28.5
12noon-1pm	189	34.5
After fter 1pm	41	7.5
<b>Day of the week</b>		
Monday	135	24.6
Tuesday	53	9.7
Wednesday	99	18.1
Thursday	69	12.6
Friday	18	3.3
Saturday	129	23.5
Sunday	45	8.2
<b>Point of delay in Consultation</b>		
Improper patient arrival pattern	101	18.4
Due to Triage	161	29.4
Examination during consultation	147	26.8
Diagnostics	72	13.1
Chemist	67	12.2
<b>Reason for delay</b>		
Many patients	245	44.7
Staff inefficiency	167	30.5
Fewer staff	136	24.8
<b>Disease diagnosed</b>		
Dengue	132	24.1
Hypertension	58	10.6
Respiratory disorder	62	11.3
Malaria/Viral Fever	70	12.8
Diabetes	58	10.6
Hormonal disorder	37	6.8
orthopedic conditions	57	10.4
skin disease	11	2
cancerous infection	5	0.9
Kidney Stones	58	10.6
<b>Satisfied</b>		
Yes	337	61.5
No	211	38.5

Table 2: Respondent Patient Characteristics at the time of Hospital OPD visit

#### 4.3. Time invested per section

As shown in table 3, most of the time of patients is invested in the pre-examination stage given by the median 42(4-132) covering nearly 50% of the overall time spent in the outpatient department for registration, triage and examination. During the pre-examination phase, the longest time of 21 min. spent in examination section, followed by the patients who were waiting to see the doctor due to triage.

Post-examination phase includes the medicals and testing required like Lab tests or X-Ray etc. In this phase, the longest time is spent at the diagnostics as given by median of 73min, due to the highest waiting time of median 36mins. The overall median waiting time including pre and post examination time was 49(10-223).

	Median Service time	Median Waiting time	Median Overall waiting time
<b>Pre-exam</b>			
<b>Registration</b>	3(2-10)	Nil	Nil
<b>Triage</b>	not applicable	20(7-33)	20(7-33)
<b>Examination</b>	6(3-32)	13(6-24)	21(4-91)
<b>Total</b>	9(6-35)	33(17-58)	42(4-132)
<b>Post-exam</b>			
<b>Diagnostics</b>	30(10-76)	22 (3-45)	45(23-89)
<b>Chemist</b>	not applicable	19(7-48)	19(7-48)
<b>Total</b>	30(10-76)	36 (9-77)	73(9-166)
<b>TOTAL</b>	10(6-95)	20(9-97)	49(10-223)

**Note:**

Service time - time patient remains in contact with a health official

Waiting time is the time a patient had to wait to receive a service.

Overall waiting time is the sum of service and waiting times.

**Table 3:** Service and waiting times (minutes) in all sections

#### 4.4. Factors associated with overall waiting time

Multivariate analysis was done for patients' socio-demographic factors and the patient experience of the service provided. The relationships which showed a statistically significant relation between the dependent variable i.e. overall waiting time and independent variable i.e. socio-demographic variables and experience factors were considered in the final model. The p-value of <0.05 was considered to be showing statistically significant relation.

##### 4.4.1. Multivariate analysis

The simple linear regression analysis was conducted of all the factors i.e. Age, Gender, weekday and Arrival Time of the patient, reason of delay and point of delay to note their relation with the overall waiting time in the hospital.

As per the table 4, the factors Age, weekday and Arrival Time of the patient were found to be having a significant relationship with  $p < .05$

PATIENT CHARACTERISTICS	Regression coefficient( $\beta$ )	95% CI	p-Value
Age	13.4	10.65 16.15	<b>0.001</b>
Gender	-5.75	-11.68 0.18	0.051
Day of the week	2.70	1.40 4.07	<b>0.001</b>
Arrival time	4.26	1.47 7.04	<b>0.003</b>
Number of patients in queue	.048	-2.02 2.98	0.71
Point of Delay	0.73	-1.53 2.99	0.53
Reason of Delay	-0.88	-4.34 2.58	0.62

**Table 4** Multivariate model showing factors associated with overall waiting time

Holding all other variables constant, age factor increases the overall waiting time by 13.4minutes (CI;10.65 - 16.15) for every additional patient in the queue. The exact age category will require further study on the available data, though the maximum foot fall comprises of patients aged above 50years, who will be impacted as per the demographic variables chart.

Holding all the other factors constant; the overall waiting time increased by 2.7minutes (CI;1.40 - 4.07) with every additional patient to the queue who reported on a crowded weekday and thus, spent much more time in the outpatient department than other weekdays. From the frequency distribution charts, it is known that the patients who arrived on Monday, Wednesday and Saturday face the crowd maximum

Holding all other factors constant, the patients arriving during the morning hours from 10:00am to 1:00pm, the overall waiting time increase by 4.26minutes (CI;1.47 - 7.04) with every additional patient in the queue.

Day of week, time of arrival and number of patients in line were found to be the only independent variable with a significant impact on overall time spent at the assessment center since when all of the variables were entered into the regression equation.

The basic purpose of this study is to improve the efficiency and quality of services delivered at the Hospitals in Noida by bringing forth some key points, which are otherwise not highlighted due to any reason.

This study has found that majority of the outpatients spend most of their time in waiting, to receive services. Most delays were seen in waiting section in triage and examination sections. The study also found that this delay was mainly due to the number of patients in the queues at different sections on certain days of the week and during some specified hours patients seek for care.

##### 4.4.2. Overall patient waiting time

The overall waiting time in the Outpatient department was highest during Monday, Wednesday and Saturday during the morning hours and was maximum for the people of age above 50.



#### 4.4.3. Bottlenecks in patient flow

Patient flow analysis showed that the longest waiting time was at triage in the doctors' lobby, diagnostics (pre-examination) and medicines (post examination).

#### 4.4.4. Factors associated with waiting time

After multivariate analysis, there were only three variables that were found to be significantly associated with patient waiting time at the assessment center i.e. patient age, time of arrival, day of arrival and number of patients in queue.

### 5.1 Study Limitations

The research was limited to the waiting time of the outpatient department. The research was limited only to the socio-demographic and post-visit factors related to the outpatient department.

## V. CONCLUSION

This study highlighted that the outpatients experience long waiting period during the peak hours in the outpatient department. The maximum waiting period is while patients wait to receive the required health services including doctor's consultation. Mostly the patients faced this delay in the doctors' lobby to consult the doctor, followed by the diagnostic section and finally at the medicine section. In the patients' opinion, this delay is due to many patients walking in for services at a given time leading to unbalanced patient arrival pattern. The service delays come due to bottlenecks at the crowded doctors' lobby after registration followed till the examination section or diagnostic section. This bottle neck puts extra pressure on the system, which works fine otherwise during other weekdays and times. The maximum waiting time is experienced on Mondays, Wednesdays and Saturday, where patients majorly walk-in directly without any prior appointment. It was observed that most of the patients required initial level of health facilities only, instead of long list of diagnostic tests or long examinations which increase the hospital waiting time. The patient arrivals system could resolve the problem to a large extent.

Further research on the age factor related delay and patient preference of particular doctors available on certain weekdays is recommended to further dig into the reasoning of uneven patient arrivals. This pattern of patient arrivals also calls for the need of an appointment system or a scheduling aid in the hospital to gradually switch to automation of working and smooth service delivery. This will also help in the management of patients with chronic conditions or regular treatment in the hospital. Patients will also feel more comfortable when they will already know the time frame meant for them with the doctor, and will also save on wastage of time and other resources.

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