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THE ANALYSIS OF APPOINTMENT SYSTEM TO REDUCE OUTPATIENT WAITING TIME AT TRICHY GOVERNMENT HOSPITAL

Dr.K.L.Muruganantha Prasad[1], D.Saraswathi[2] , Dr.R.Winson[3]

1Assistant Professor,PG and Research Department of Mathematics,

H.H.The Rajah's College, Pudukkottai, Affiliated to Bharathidasan University, Tiruchirappalli,

Tamilnadu, India. Email:lkmprasad@gmail.com

[2]Research Scholar, PG and Research Department of Mathematics,

H.H.The Rajah's College, Pudukkottai, Affiliated to Bharathidasan University, Tiruchirappalli,

Tamilnadu, India. Email: sarasraja1820@gmails.com

[3]Lecturer in Mathematics,Higher college of Technology,Muscat,Sultanate of Oman,

Email: winsonnr@yahoo.co.in

Abstract: Outpatient services have become an important part of health care. By hide-bound thinking, the medical profession emphasized that a physician's time is more valuable than a patient's time. More over the appointment system was designed to minimize physician's idle time overlooking patient's waiting time. This is no longer valid in today's consumer oriented society. Long waiting times for treatment in the outpatient department followed by short consultations has an unavailable situation. Nowadays, customers use waiting time as a decisive factor in choosing a service provider. Therefore, idle time of both parties must be considered in designing an appointment system although these two objectives are contradicted to each other. This research aim to provide a study of the major causes of patients length of time for medical treatment in a outpatient in G.H Tamilnadu and also provide recommendation on the best strategy to improve the appointment system so that can maximize the effectiveness and efficiency of resource and capacity.

Key words: Appointment system, Outpatient Waiting Time, Queue Theory.

1. Introduction

Patient satisfaction has become a important topic in service area. On Healthcare industry, a number of initiatives have been introduced to increase patient satisfaction. The healthcare industry provides globally are experiencing increasing pressure to simultaneously reduce cost and improve the access and quality of care they deliver. Any healthcare institutions are confronted with long waiting times, delays, and queues of patients. Typical questions challenging hospital managers include: How should

they optically allocate their limited resources? How much exam rooms do they need? How much physicians and supporting staff do they need? If they increase or decrease the amount of exam rooms and / or staff, how would this effect patient waiting time, the length of a medical treatment and the total time spent in clinic by patient. To improve patient satisfaction , the performance of key processes has to be improved [1].

Practical issues such as the ease of use of the appointment system, or implications on modifying physicians' behaviour need to be considered in order to achieve the ultimate goal of improving "real systems". It may also be interesting to determine what are the most commonly used appointment system in practice. There is a lack of emphasis on the real-life performance of appointment system implemented as a result of studies. Discussions on implementation issues reveal how misleading it can be to view the problem as a "pure optimization" problem [2].

Effectively managing patient flow in an outpatient unit is a key to achieving operational excellence as well as ensuring clinical quality. It is especially so for an outpatient department in a large hospital as it handles very large volume of type of patients.

There is a need for more realistic representation of outpatient clinics. Effective appointment systems have the goal of matching demand with capacity so that resources are better utilized and patient waiting times are minimized. Patient waiting times and waiting-room congestion 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, many patients government hospital prefer to move to private hospital to do medical check-up and treatment. Its means are the hospital management should be improved to increasing patient satisfaction.

This study allows the hospital to notice what impact has the improvement do in the hospital performance. Moreover, this study will show what factors can be improved in reducing patient waiting time. This research expected to bring new ideas and concept to be implemented in hospital in Trichy especially government hospital since the numbers of researches about this field are limited. Research question for this paper are:

• How does the model of outpatient service and arrival pattern of patient in government hospital?
• Is an existing outpatient service already fulfilling the minimum service standard of hospital?
• What factors causing high outpatient waiting times? The objective of this paper is to investigate how does the model of outpatient waiting time and patient scheduling on hospital and find out the factors that causing the stack.

2. Service Operation in Healthcare:

Healthcare service is a patient-oriented service that requires continuous interaction with patients. It utilizes facilities and equipment, and consumes a large volume of nursing care. Therefore, it becomes increasingly important to 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 [3]

Until now research on operations strategy in government hospitals has not been well developed, especially when it relates operations strategy to the current health service condition. Most of the operations-oriented studies focus narrowly on issues of hospital cost containment, capacity planning, or personnel scheduling [3].

Healthcare management has developed into a dynamic and complex field. The changes have moved on to determine new ways about how and where healthcare is provided.

Li et al.[3] 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 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, walk-in clinics, and other health-oriented businesses [4].

3. Outpatient Service

Outpatient services are gradually becoming an essential component in healthcare. The development of the times, technology and the rapid increase in population make the theories need to be developed. The objective of outpatient scheduling is to and an appointment system for which a particular measure of performance is optimized in a clinical environment—an application of resource scheduling under uncertainty. As seen as Figure 1, Cayirli and Veral [2] discussion about modelling of clinic environment.

The underlying problem applies to a wide variety of environments, such as general practice patient scheduling, scheduling patients for hemodialysis, radiology scheduling, surgical scheduling, etc.

4. Involvement of Queuing Theory

Queuing is an event where people or goods will undergo a process from the arrival queue; enter the queue, waiting, until the last service. Waiting line or queuing system is an items 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 FCFS. (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 [5].

5. Factor That Influenced Outpatient Service 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). [6]

Based on Cayirli and Veral [2], 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 is 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 describe factors that influenced on design appointment system.

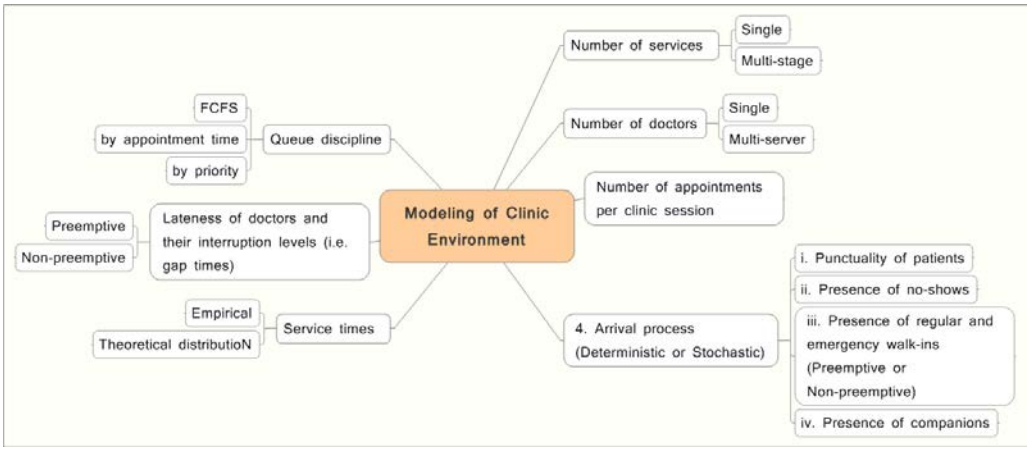

Figure 1. Modelling of Clinic Environment [2]

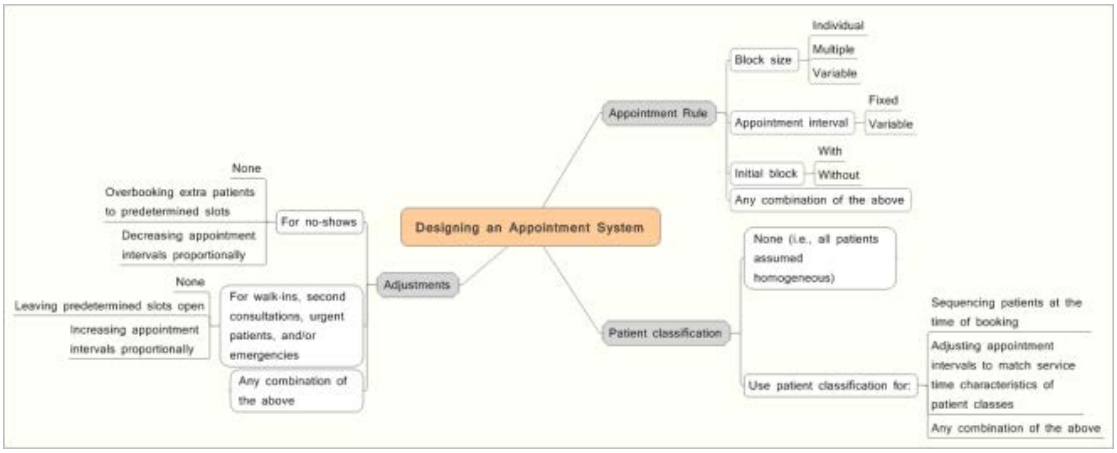

Figure 2. Design of Appointment Systems [2]

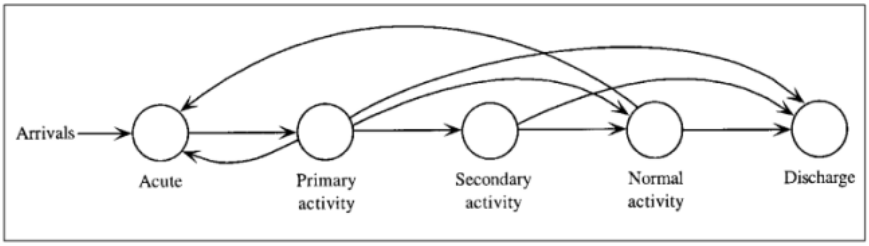

Figure 3. Patient Flows for Discharged Alive Coronary Patients (clinical)

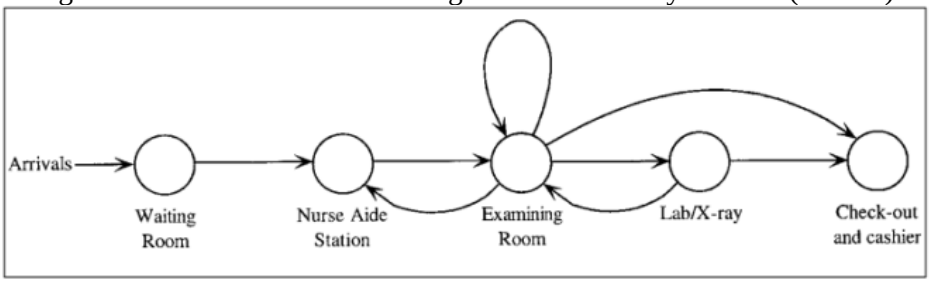

Figure 4. Patient Flows for Patients at a Family Practice Clinic (operational)

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 [7].
Based on Cote [8], 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.
It will describe by the following figure:
Figure 3 is an example of an inpatient medical condition and illustrates the possible recovery paths associated with a group of discharged alive coronary patients. In contrast, Figure 4 is an outpatient application of a family practice clinic's patient-care episodes.
In particular, resource planning, scheduling, and utilization are all affected by patient flows. 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.

6. Methodology Research

6.1. Research Paradigm

This research is a positivist social science, because this study is research that emphasizes the legal phenomenon of cause and effect of a condition. The research is done by using the empirical observation made cautiously [9]. 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 [9].
6.1. Data Collection
This research is using interview to see the appointment system and the factor that effect patient waiting time. Initial interview was conducted with key informant in outpatient department to get information about general overview of outpatient system. After that, interview will be conduct to collect more data and information related to this study. The information will be used to how the model of outpatient service and arrival pattern of patient in public hospital.
The field work pertaining to business process will be conduct. The observations include field visit to public hospital and to see directly outpatient service and arrival pattern of patient in public hospital.
Secondary data will be collected from previous research that conducted by hospital, national and international journal to complete the information regarding outpatient waiting time and patient scheduling.

7. Data Calculation and Analysis

7.1. Descriptive Analysis

The hospital has two kinds ambulatory service. One service is general outpatient clinic that was treated by residency. The study was conducted in Specialty Outpatient Clinic. This clinic has eleven specialists. They are: internal medicine, obstetrics and gynaecology, general surgery, orthopedic, neurosurgery, dermatology and venereology, neurology, medical rehabilitation, pediatric, psychiatry and ophthalmology.
Observations made during a month. After the observation, it was decided for data retrieval done on Monday and Tuesday, which is on the busy days of the week. The data used are the number of patient arrivals per specialist per day, arrival time of doctor and patient, length of registration service and the duration of examination.
From one month of the observation, it was found the average number of patient per hour. From the Table 1, it shows the high arrival rate on Monday and Tuesday. Internal medicine always takes a large number of patients.

Table 1. The average number of patients per day

Specialist	Mo	Tus	Wed	Thr	Fri
Internal Medicine	52	52	38	34	30
Obstetrics and gynaecology	20	16	25	16	15
General Surgery	47	29	32	30	22
Orthopaedic	13	10	6	9	5
Neurosurgery	9	3	2	4	2
Neurology	13	6	12	10	4
Dermatology and	14	8	14	9	5
Medical Rehabilitation	2	1	3	2	0
Pediatric	1	0	1	0	0
Psychiatry	0	2	0	0	1
Ophthalmology	1	1	0	1	1

Table 2 shows the time of patient arrivals. A large number of patients come between 08.00 am to 11.am. This condition thought to lead to a long patient waiting times. So, this research will focus on the busy hours. The patient arrival rate on busy hours is 30 people per hour.

Table 2. The average number of patients' arrival per hours

Time	num of patient/ day			
	1 (Mo)	2 (Tu)	3 (Mo)	4 (Tu)
< 07 : 59	2	1	4	4
8: 00 : 8 :59	36	28	28	30
9 : 00 : 9:59	35	28	47	25
10: 00 : 10:59	46	27	24	23
11 : 00 : 11:59	16	17	19	18
12 : 00 : 12: 59	10	10	7	5
13 : 00 : 13 : 59	6	6	4	3
> 14 : 00	3	2	1	2

This Clinic has over 30 sub-specialists. The number of existing space is 10 rooms and 172 doctors. The highest level of patient arrival is at the beginning of each week. The clinic implements the single block system. The patient was not scheduled to come before. The physician appointment system is on call. The doctor comes when patients arrive. The problem of this system is the first patient will have a longer waiting time.

The condition is compounded because the hospital has not yet allocate doctor schedule by room and type of disease. When the condition is all the doctor came at the same time, there is no empty room or all of the tools being used, so that both physician and patients have to wait even longer. At other times, the room become idle. The waiting time becomes higher because hospital did not allocate and well-scheduled their resources. The clinic has an effective operating time for six hours, but many patients accumulated at one time.

Therefore, this study would like to implement individual block schedule. By implementing an appointment system, the clinic is able to optimize the resources and capacity. Patients were also more likely to be served and patient satisfaction will increase. It does not mean to expect more people to be sick. The existing conditions, the number of patient are large compare to the hospital capacity. Consequently, many patients run to private hospitals and even abroad for better treatment.

7.2. Appointment System

Existing appointment system which applied in this clinic is the single block rule. It assigns all patients to arrive at the same time. The patients are served on a first come first serve basis. The queue system is single channel multiple phase with two single server. The current queue model is M/M/1/I, which means the pattern is random arrival. The service pattern is also random that follows Poisson distribution. The number of facilities is only one with infinite population. It has waiting line in each server. The queue model will be shows as the figure below.

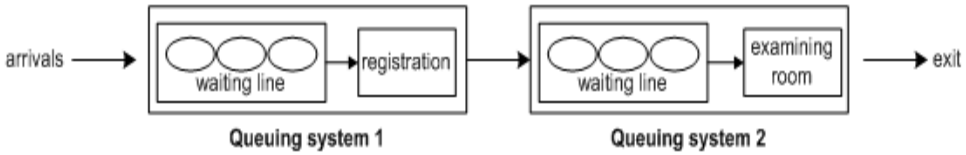

Figure 5. Queuing Model for Specialist Outpatient Clinic

The detail of queue model can be seen from the following patient flow diagram.

From the Figure 6, there are two type of patient on specialist outpatient clinic, one type is patient that already a member, and the other is patients that come for the first time. The new member need to pre-register on information desk by filled the registration form. There is no queue on information desk, so this server was not considered on this research. After registration, the patient is waiting for the treatment (next server). On the other hand, medical record staff will look for the patient record file. Time taken to search medical records is relatively shorter than patients waiting for the doctor. The patients will not go home. They still have another choice. It can be one, two or all three alternative; supporting treatment, cashier, or pharmacy.

7.3. Outpatient Waiting Time

The ambulatory facilities are designed to make more effective use of patients' and doctors' time. The queuing formula for model single channel system that used was:

$$P = \frac{\lambda}{\mu} \quad (1)$$

$$Ls = \frac{\lambda}{\mu - \lambda} \quad (2)$$

$$Lq = \frac{\lambda^2}{\mu(\mu - \lambda)} \quad (3)$$

$$Ws = \frac{1}{\mu - \lambda} \quad (4)$$

$$Wq = \frac{\lambda}{\mu(\mu - \lambda)} \quad (5)$$

This is the definition of a few terms:

λ	=	Arrival rate
μ	=	Service rate
P	=	Average server utilization
L_q	=	Average number of customers in the queue
L_s	=	Average number of customers in the system
W_q	=	Average waiting time in the queue
W_s	=	Average time in the system

Based on calculation for first server using one month daily data, the table below was the result. The average time need on waiting for the patient is 0.3hours, or 18minutes.

Table 4 show the condition on three specialists; internal medicine general surgery and obstetrics & gynecology. This calculation didn't consider the capacity of the room. Internal medicine has a higher waiting time. It is about 0.54hours or 33minutes. General Surgery has 14 minutes and obstetrics & gynecology has 9minutes.

From two tables above, it can be predict the patient waiting time ranged between 27-51minutes. Based on the minimum standards of hospital care, outpatient waiting times should be less than 30 minutes. This time is calculated from the first patient enrolled until physician served. Since the calculation of the patient's waiting time separately (not considering doctor arrival time), the waiting time of patients still within reasonable limits. In fact, there are even patients who have to wait more than three hours. The main causes of long waiting times patients are physicians who are not available any time.

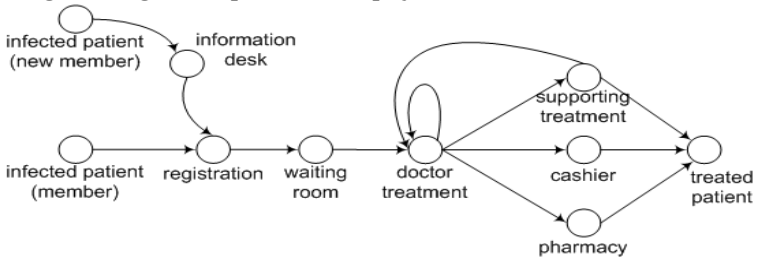

Figure 6. Patient Flows for Specialist outpatient Clinic

	Registration	
Arrival rate (λ)	28	
Service rate (μ)	30	
Average server utilization(P)	0.93	%
Average number of customers in the queue(Lq)	13.02	People
Average number of customers in the system(Ls)	14	Peoples
Average waiting time in the queue(Wq)	0.47	Hours
Average time in the system(Ws)	0.5	Hours
Probability (% of time) system is empty (P0)	0.07	%

Table 3. Calculation Result for First Server

Table 4. Calculation Result for Second Server (medical treatment)

	Internal Medicine	General Surgery	Obstetrics &gynecology	
Arrival rate (λ)	6.9	6.1	3.1	
Service rate (μ)	8	8	6	
(P)	0.86	0.76	0.52	%
(Ls)	6.3	3.2	1.07	People
(Lq)	5.4	2.4	0.56	Peoples
(Ws)	0.91	0.52	0.35	Hours

(Wq)	0.78	0.39	0.18	Hours
(P0)	0.14	0.24	0.48	%

8. Conclusions and Future Research

Based on the problem of specialist outpatient clinic which is about the length of patient waiting time and it impacts to the performance of the hospital that become the reason of this study. This research provides suggestion to the hospital to construct the appointment system, take attention of patient flow and set scheduling of the capacity to increase the effective and efficiency outpatient department performance. The most suitable appointment system for outpatient is using no-show. The condition that affect patient waiting times are the physician come on call, go show patient, no proper calculation of the room capacity, the number of physicians and the number of sub-specialists. This research is a preliminary study that analyzed each variable separately. Analysis was performed to confirm that the waiting time targets not met the minimum service standard of hospital.

Research continues as intended by examining all variables simultaneously. These variables are appointment system (patient scheduling), patient flow, capacity and behavior of the physician. For the future, further analysis is still required to design this system such as make a simulation of all variable that affects bottleneck and it supposed to make the clinic performance more effective and efficient.

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