

Service System of Doctor's office

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Abstract

This paper deals with analyzing queueing system in a doctor's office in Vienna in order to understand whether combination of internet and phone-based appointments system helped to reduce queues in a waiting room. As it can be concluded from the analyses of queueing systems, utilization rate in the queue to the administrator is rather low – 25 %. However, registering of new patients is not the main work of administrators. They have to answer calls, help with paper work, make appointments etc. Waiting time in this queue is low, patients are served quickly and no improvements are needed. The second queue, to the doctor, has high utilization rate, as doctor is working with short breaks only but also long mean waiting time in a queue.

Keywords 1

Service system, doctor's office, health care, patient, decision making

1. Introduction

The new emphasis on patient-centeredness is changed health care system. This is caused by increasing recognition of patients' role in health care system. Medical appointment scheduling is undertaking main developments to support active involvement of patients. Patients are more independence in decision making [1] about their preferences for the appointments [2, 3]. The aim of our research is to analyze queueing system in a doctor's office in Vienna in order to understand whether combination of internet and phone-based appointments system helped to reduce queues in a waiting room.

For this research, we have chosen the office of the Dr. Manon Der-Petrossian [4]. Ms Der-Petrossian has been granted a doctoral degree in general medicine in 1998. In the same year, she has begun her training in the field of dermatology and she wrote a dissertation in the University for Dermatology.

Since 2004 Dr. Der-Petrossian has degree in Dermatology and have been working in several hospitals, published scientific papers. She is also a member of the Austrian Society for Dermatology and Venereology.

Dr. Der-Petrossian can provide her service in German, English, Armenian, Persian and French.

In 2005 Dr. Der-Petrossian has opened her own praxis. After resettlement in 2015, the office is in 22nd district in Vienna.

In the praxis are working 3 administrators and 2 assistants. Following services are provided in the praxis:

- General dermatology - diagnosis and treatment of "everyday" skin diseases such as acne, blemished skin, eczema, rash, itching, hair loss, dandruff etc.

IT&AS'2021: Symposium on Information Technologies & Applied Sciences, March 5, 2021, Bratislava, Slovakia

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CEUR Workshop Proceedings (CEUR-WS.org)

- Skin cancer prevention - melanoma, basal cell carcinoma, squamous cell carcinoma - these dangerous skin cancers can be successfully treated if they or their precursors are detected early.
- Check of birthmarks - this essential component of the skin cancer screening takes place in the ordination by default with the dermatoscope (incident light microscope). In addition, it is offered the possibility of digital birthmarks registration using the Mole Max device.
- Pediatric dermatology - Atopic dermatitis (eczema), rashes, warts, allergies, congenital skin diseases etc.
- Infectious skin diseases and venereal diseases - the skin as an interface to the environment is the first contact point for bacteria, viruses, fungi and parasites. Also, in our time are illnesses such as herpes, scabies, Candida or Borreliose frequently.
- Operative dermatology - operations of birthmarks, tumors and cysts are performed personally in the ordination. The removal of pathological or cosmetically disturbing skin changes of all kinds takes place in local anesthesia practically pain-free.
- Light therapy - treatment of psoriasis, chronic eczema, itching and many other skin diseases with therapeutic UV light (modern full-body cabin, optionally with narrow-band UVB or PUVA)
- Hyperhidrosis - advice on treatment options for excessive sweating of the hands, feet and armpits. Treatment of armpits with botulinum toxin.
- Varices - varicose veins and spider veins can be obliterated in the course of a simple and less stressful procedure and thus be made to disappear.
- Botulinum toxin - For smoothing facial wrinkles such as wrinkles, crow's feet and forehead wrinkles. For this purpose, the smallest amounts of botulinum toxin are injected with an extremely fine needle into the area of the facial muscles to be treated. The treatment is virtually painless and therefore feasible without local anesthesia.

Evaluation of the doctor's office on docfinder [5].at has the rating of 4, with 4.4 – mean for the doctor's service and 3.6 for the long waiting time in a queue. These are some evaluations from patients:

- „...The doctor was very friendly, took enough time to examine all my problem areas, examined me very thoroughly and then prescribed me an ointment for my eczema, which helps me a lot (after another doctor only said I should less hands wash and did not write anything to me). She explained everything to me in great detail, so that I feel taken seriously as a patient and feel well advised. I will definitely go back here!“
- „In January I had made an appointment for the beginning of April. Unfortunately, you have to wait so long for an appointment with such a competent doctor. Nevertheless, I was very satisfied with the treatment. She could actually help me, for which I am very grateful. Well, I also found the procedure that an assistant first recorded my medical history and Dr. med. added later...“
- “It really has to be said here how excellent this ordination is. A more than competent and warm doctor. Friendly, helpful and competent assistants. I have already experienced how some patients behave rude and aggressive to personal [5-9]. How to call in the forest. And the ladies at the reception always kept their nerves and stayed friendly. A compliment to the whole team!”

However, positive critic in internet leads to long waiting time on an appointment. Dr. Der-Petrossian is working with all insurance companies as well as as private doctor.

1.1. Description of the service system

In order to meet the doctor first a patient hast to arrange an appointment. It can be done online on the website of the praxis or via telephone. Then a patient is coming to the doctor's office and need to register by an administrator. An Administrator putting information about the patient into computer, sends it to the computer of assistant. The patient is waiting in a waiting room until he/she will be called.

Assistant meets the patient, runs pre-examination and after it calls Dr. Der-Petrossian.

According to the system two queues occur:

- First one to the administrator in order to register
- Second one to the doctor.

Furthermore, some patients without appointment but with an urgent case are coming and have to wait on a free spot. Regarding all mentioned above we have created following model.

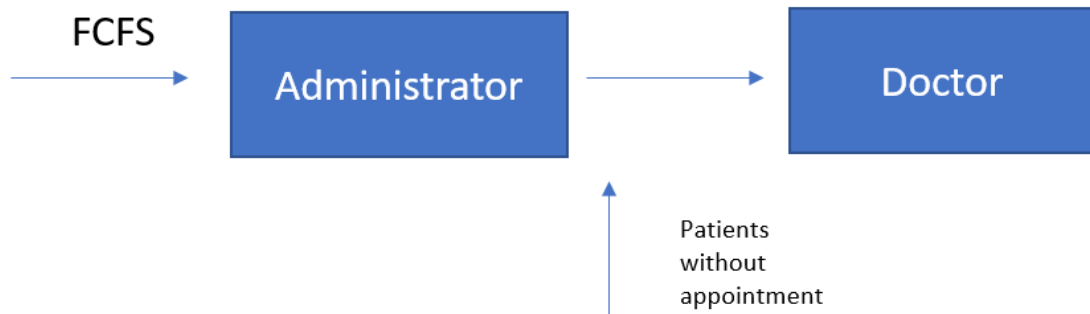


Figure 1: Model of appointments of doctor's office

Observations. The praxis has following office hours: Monday: 10:00 – 18:00, Tuesday: 09:00 – 14:00, Wednesday: 7:30 – 12:30, Thursday: 14:00 – 19:00, Friday: 8:00 – 13:00.

We went to the praxis on Monday and found out that in a high season (winter, when cold works as trigger and summer, when sun works as trigger) office hours are extended. For example, on Monday ordination was opened from 9:00 to 19:00. In this period, 27 patients with appointment and 3 without appointment were served.

Administrator revealed that mean service time is 18 minutes and they plan an appointment each 20 minutes. 40% of the appointments are done via internet and 60% via telephone.

1.2. Analyses of queueing systems

As already mentioned above, in order to analyze the service system at doctor's office, we went to the praxis on a Monday.

The total number of patients observed was 30 (27 patients with appointment and 3 patients without appointment) and according to the administrator was the mean service time 18 minutes and they plan an appointment each 20 minutes.

1.3. Queueing system to the administrator

First, we analyzed the queueing system to the administrator. In the process, a system bottleneck occurred: as a result, that the doctor has the smallest capacity, the administrator cannot serve more patients than 3 per hour. This means that the doctor can treat 3 patients per hour. From there, the mean rate of arrival for patients to the doctor's office administrator was provided to us from the administrator.

On top of that, the mean service time was calculated to assess the time needed for the administrator to transfer the data of the patients from the registration form to the computer system or for making phone calls.

$$\mu = \frac{1 \text{ patient}}{5 \text{ min (1 h/60min)}} = \frac{1}{0,083} = 12 \text{ patients per hour} \quad (1)$$

According Markov chain model [10], this means that the queueing system can serve 12 patients per hour. Then, we calculated the utilization of the server:

$$\rho = \frac{\lambda}{\mu} = \frac{3 \text{ patients/hour}}{12 \text{ patients/hour}} = 0,25 = 25\% \quad (2)$$

This means that during 25 % of the time observed, at least one patient was served. The following formula calculates the mean number of patients in the queue:

$$L_q = \frac{\rho^2}{1-\rho} = \frac{0,25}{(1-0,25)} = 0,083 \quad (3)$$

In the observed period, 0,083 patients were waiting in the queue on average. This leads to the mean wait per patient of 1,66 min

$$Wq = \frac{Lq}{\lambda} = \frac{0,083}{3} = 0,0278 = 1,66 \text{ min} \quad (4)$$

and a mean wait in the system of 6,66 minutes.

$$W = Wq + \frac{1}{\mu} = 0,0278 + \frac{1}{12} = 0,1111 = 6,66 \text{ min} \quad (5)$$

Based on these calculations, the mean number of patients in the system was calculated with the formula:

$$L = \lambda * W = 3 * 0,111 = 0,33 \quad (6)$$

Hence, a total of 0,33 patients per minutes was visiting the administrator. Additionally, we analyzed the proportion of time were the server was idle which is given through the following formula:

$$1 - \rho = 1 - 0,25 = 0,75 = 75\% \quad (7)$$

Consequently, during 75 % of the service time the server is idle. That means that in this time the administrator serves no patient.

1.4. Queueing system to the doctor

Analogue to the queueing system to the administrator, the mean arrival rate of patients to the doctor was provided:

$$\lambda = 3 \quad (8)$$

Additionally, the mean service rate was calculated as follows:

$$\mu = \frac{1 \text{ patient}}{18 \text{ min (1 h/60min)}} = \frac{1}{0,3} = 3,33 \text{ patients per hour} \quad (9)$$

That means, the doctor can treat 3,33 patients per hour. In the next step, we calculated the server utilization:

$$\rho = \frac{\lambda}{\mu} = \frac{3 \text{ patients/hour}}{3,3 \text{ patients/hour}} = 0,91 = 91\% \quad (10)$$

This means that during 91 % of the time observed, at least one patient was treated by the doctor. The following formula results the mean number of patients in the queue:

$$L_q = \frac{\rho^2}{1-\rho} = \frac{0,91^2}{(1-0,91)} = 9,201 \quad (11)$$

In the observed period, 9,201 patients were waiting in the queue on average. This leads to the mean wait per patient of 3 hours and 7 minutes.

$$Wq = \frac{Lq}{\lambda} = \frac{9,201}{3} = 3,067 = 184,02 \text{ min} = 3,07 \text{ h} \quad (12)$$

and a mean wait in the system of 3 hours and 37 minutes.

$$W = Wq + \frac{1}{\mu} = 3,067 + \frac{1}{3,33} = 3,367 = 202,04 \text{ min} = 3,37 \text{ h} \quad (13)$$

After that, we calculated the mean number of patients in the system:

$$L = \lambda * W = 3 * 3,367 = 10,1 \quad (14)$$

This results in a total of 10,1 patients per minutes were visiting the doctor.

Additionally, we analyzed the proportion of time were the server was idle which is given through the following formula:

$$1 - \rho = 1 - 0,91 = 0,09 = 9 \% \quad (15)$$

Therefore, during 9 % of the service time the server is idle, which means that the doctor is not treating a patient.

2. Conclusions

As it can be concluded from the analyses of queueing systems [10], utilization rate in the queue to the administrator is rather low – 25 %. However, registering of new patients [11-13] is not the main work of administrators [14-19]. They have to answer calls, help with paper work, make appointments etc. Waiting time in this queue is low, patients are served quickly and no improvements are needed.

The second queue, to the doctor, has high utilization rate [20], as doctor is working with short breaks only but also long mean waiting time in a queue.

We have spoken to patients and they told us that our calculations make sense as they usually wait at least one hour even with an appointment [21-29]. It can happen due to following problems:

- Some patients are coming later and the whole system has to adapt to it
- Time spend by the doctor varies from 10 minutes to 1 hour
- In a high season more patients with urgent case are coming without an appointment

We suggest further improvement in order to shorten waiting time and increase customer satisfaction:

- Plan appointments not every 20 minutes but according to the problems of patients [30-31] which administrator can ask while making an appointment via telephone
- Ask more information about the problem in online appointment system [32]
- In a high season invite additional doctor in order to shorten waiting time on an appointment
- City of Vienna have to rethink their health care system as long waiting hours are almost by all doctors and hospitals.

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