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Analysis of Density and Patient Wait Times In Terms of System Management In Turkish Hospitals: Setting A Pattern by Days and Hours of The Week

Türk Hastanelerinde Sistem Yönetimi Açısından Yoğunluk ve Hasta Bekleme Sürelerinin Analizi: Haftanın Gün ve Saatlerine Göre Model Oluşturma

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ABSTRACT

The time spent waiting is an important problem regarding patient satisfaction and hospital efficiency, and increases the need for evidence-based information for management to make decisions towards a solution. This study aims to examine the process flows in hospitals based on actual data with the intent to design a better service delivery system and set a pattern in terms of determining the congestion in the process and planning the necessary improvements. For this purpose, the data sets for 2016 pertaining to secondary and tertiary level hospitals in Turkey, which are stored in the central physician appointment system (CPAS), are investigated. The data is analyzed through pre-processing, cleaning and transformation stages. Congestion patterns are determined by days and hours spent in hospitals. Monday is found to be the day with the highest patient density and the longest wait time in Turkish hospitals. Additionally, when analyzed by working hours, it is determined that the first 2 hours in the morning (9.00 a.m. to 11.00 a.m.) is the period when most patentse are examined. The lunchtime (between 12.00 p.m. - 1.00 p.m.) and the afternoon from 4.00 p.m. to 5.00 p.m. are the times when patient density is the lowest, but average wait time is the longest. Turkish hospitals are found to be particularly congested on some days and during some hours regarding patient wait times. Thus, policy recommendations can be developed specifically to the days and times when congestion patterns are identified rather than suggesting a general policy. This study is the most comprehensive study conducted in Turkey through process data. The working model is reproducible in different countries and regions.

Keywords: Patient Wait Times, Health Services Planning, Health Information, Healthcare Management, Health Policy

ÖZ

Bekleme sırasında geçirilen zaman hasta memnuniyeti ve hastane verimliliği açısından önemli bir sorun oluşturmaktadır ve yönetimin çözüme yönelik karar alabilmesi için kanıta dayalı bilgiye duyduğu ihtiyacı artırmaktadır. Bu çalışma, daha iyi bir hizmet sunum sistemi tasarlamak için hastanelerdeki süreç akışlarını gerçek veriler üzerinden inceleyerek, süreçteki yoğunlukların tespit edilmesi ve gerekli iyileştirmelerin planlanması açısından bir model oluşturmayı amaçlamaktadır. Bu amaç için, Türkiye'de 2. ve 3. basamak sağlık kurumlarına ait ulusal randevu sistemi (MHRS) üzerinde depolanan 2016 yılına ait veri setleri incelenmiştir. Veriler; veri ön işleme, temizleme ve dönüştürme aşamalarından geçirilerek analiz edilmiştir. Hastanelerdeki gün ve saatlere göre yoğunluk örüntüleri tespit edilmiştir. Türkiye'deki hastanelerde pazartesi gününün, hasta yoğunluğunun en fazla olduğu ve en uzun bekleme süresine sahip olan gün olduğu görülmüştür. Bunun yanında, mesai saatlerine göre analiz edildiğinde, sabah ilk 2 saat (9.00-11.00) en fazla hastanın muayene edildiği dönem olduğu tespit edilmiştir. Öğle saati (12.00-13.00 arası) ve öğleden sonra saat 16.00-17.00 arası ise hasta frekansının en düşük, ancak ortalama bekleme süresinin en uzun olduğu zamanlardır. Çalışma sonuçlarına göre, Türkiye'deki hastanelerde hasta bekleme sürelerinin özellikle bazı gün ve saatlerde yoğun olduğu tespit edilmiştir. Böylece genel bir planlama önerisinden ziyade yoğunluk örüntülerinin tespit edildiği gün ve saatler özelinde politika önerileri geliştirilebilir. Bu çalışma, süreç verileri üzerinden Türkiye'de yapılan en kapsamlı çalışmadır. Çalışma modeli farklı ülke ve bölgelerde tekrarlanabilir niteliktedir.

Anahtar Kelimeler: Hasta Bekleme Süreleri, Sağlık Hizmetleri Planlaması, Sağlık Bilişimi, Sağlık Yönetimi, Sağlık Politikası

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INTRODUCTION

It is globally recognized that in a well-designed healthcare management system, patients do not have to wait long for an appointment and examination [1]. Patients spend a significant amount of time waiting for services to be delivered by doctors and other healthcare professionals in outpatient clinics. The time spent waiting is an important problem for both hospital administrators and policy makers in terms of patient satisfaction and hospital efficiency [2]. To tackle this problem, policy makers in Canada, Australia and the UK have launched health reforms that include setting targets for patients' time in the department [3]. However, waiting does not only lead to economic costs such as opportunity cost for the society, but also psychological burdens that correspond to the stress experienced during the waiting period [4,5]. It is not surprising that access problems have negative consequences for patients. Prolonged delays in access to healthcare services (wait times) and delays in diagnosis, treatment or follow-up can directly affect the patient's health. Studies in the literature suggest that reducing patient wait times is considered a priority in health systems [6,7].

Any lack of coordination in health service delivery or inefficiency of the health care organizational culture will lead to disruption of the service flow, insufficient use of resources, and an imbalance between the service demand from patients and the service provision by service providers, and long wait times [8,9]. Thus, the complexity and process dependencies of health systems further complicate this situation [10]. The complexity of the patient's route within the healthcare facility results in managerial difficulties, and this complexity itself increases the need for evidence-based information for management to make decisions towards a solution. At this point, examining the patient flow and monitoring the waiting points can provide the evidence-based information needed by managers to improve the situation. Thanks to this information, patient routes can be changed; workforce distribution can be organized; and an effective management is possible by developing a planning model for each process or seeking any other solutions [11].

Additionally, both a strong theoretical logic and a growing number of case studies support approaches which discuss the fact that a poorly designed system, rather than an absolute lack of capacity, may often be the root cause of long wait times [12]. Given the evidence that poorly designed systems cause significant waste of time and resources, analyzing wait times seems to be a very attractive and practical starting point for redesigning such systems [13]. Effective appointment systems aim to match demand with capacity for better use of resources and minimization of patient wait times. The Turkish Ministry of Health launched the Centralized Physician Appointment System (CPAS) in 2010 throughout the nation as part of the Health Transformation Program so that more effective and efficient health services are accessible in Turkey [14]. The main goal of CPAS is to provide a calmer and more peaceful environment for everyone by eliminating the wait time before the examination in hospitals and reducing the crowds in front of hospitals and polyclinics. The aim is to allow citizens to manage their own time properly.

By using the data collected in CPAS effectively and measuring the use and distribution of resources in hospitals, the efficiency and quality of healthcare services are increased, and the development of health policies are facilitated, and the physician workforce in hospitals is used effectively [15]. Determining the wait times, which affect patient satisfaction and work efficiency in diagnosis and treatment processes and which result in economic and psychological costs, as a well-defined and measurable indicator will make it an important tool for monitoring improvements in the system design.

While access to healthcare services and wait times are an important issue, the data

required to work in this area is very limited. Consequently, there is an important deficiency in evaluating the prevalence and effects of these problems in terms of standards accepted worldwide in research projects [16–18]. The most important source for creating evidence-based information that will increase the quality of healthcare service is health information technology infrastructure. Most studies in the literature are based on surveys, direct observations, or retrospective calculations from records of wait times [13,19–22]. According to a study published in 2017, the studies on the calculation of wait times in hospitals based 1on the process records of health service delivery are very rare [1].

A study analyzing wait times using appointment system data was conducted in Turkey limited only to three hospitals [23]. The use of CPAS in Turkey over the years and the problems conveyed to the ministry within the CPAS have been discussed in this study. However, since the data on waiting times are limited to only three hospitals, the relevant study findings cannot be generalized across Turkey.

This study analyzed the 1-year CPAS data about patients admitted to outpatient clinics to have health care services in public hospitals in Turkey. Upon this analysis, the aim was to reveal the differences in patient wait times by the days and hours of the week and to investigate the effect of the national appointment system on wait times. Thus, the base of will be laid for the observation and follow-up of system improvement efforts through objective measurements independent of patient perception. It is important that the study fills an important gap in an area where almost no study is conducted due to the lack of process and procedural data. The results obtained will provide evidence-based data for both hospital managers and policy makers to improve health service delivery.

METHODS

The scope of this study consists to the year 2016 data sets of the second and third line hospitals owned and managed by the Turkish Ministry of Health. Since our study was a retrospective and record/registry-based study, any personal information of patients was not used in this study. Thus, patient approval was not required. Necessary access permissions were obtained from the Ministry of Health. The use of data in this study was approved by the Istanbul Medipol University Non-Interventional Clinical Research Ethics Committee (2017/520). Within the scope of the study, the necessary legal and ethical documents and permissions were obtained and all protocols in the study were carried out in accordance with the relevant guides and regulations. Sample selection is determined using the European Union's Classification of Territorial Units for Statistics (NUTS). Provinces in the NUTS 2 region are grouped together because they have common problems, are socioeconomically and culturally similar, and geographically similar. The characteristics of the populations in this group offer comparison opportunities that can be used to explore practices and policies in the region [24]. This study discusses state secondary and tertiary hospitals located in the central provinces of the 26 geographical borders in the NUTS-2 region.

For the study data, the anonymized data sets for 2016 were accessed through the national appointment system CPAS of the Turkish Ministry of Health. The study is a quantitative, retrospective, cross-sectional study that analyzes the wait times of outpatients in 2016. The data obtained were analyzed by data exclusion, data cleaning and data transformation phases.

The analysis excluded the public secondary and tertiary level hospitals to which less than 4.000 outpatients and less than 100 inpatients are admitted per month, and the hospitals that opened for the first time in 2016. In addition, emergency room examinations were excluded from the analysis.

To develop the data for calculation, the records containing the "Processing Time and

Appointment Time" from 9.00 a.m. to 4.00 p.m. on weekdays were included in line with the defined regular working hours for each facility, while any records that took place outside these parameters were excluded from the analysis.

During the data pre-processing phase, the collected data were cleaned according to data types (nominal, sequential, continuous, range, etc.). During the cleaning phase, the status of missing, noisy or inconsistent data was evaluated and assessed for data quality according to criteria, such as validity, completeness, consistency, uniformity, density uniqueness, accuracy, integrity, etc. [25,26] The records that were not suitable for analysis based on these criteria were excluded. The data were pre-processed, analyzed and visualized using Qlikview™, a business intelligence tool [27], that was installed on a server allocated by the Ministry of Health. The data were not physically exported from that server even after anonymization.

The patient wait time is calculated as shown in the equation.

$$Patient\ Wait\ Time\ (min) = Physician\ Visit\ Start\ Time - Registration\ Time$$

RESULTS AND DISCUSSION

3.1. Wait Times Analysis by Days

Patient average wait times and standard deviation values for examination procedures by days are shown in Table 1.

Comparing the wait times for patients with and without appointment by days, no significant difference was observed on Mondays ($p>0.05$), while the wait times for patients without appointment on other days were significantly higher than those for patients with appointment ($p<0.001$).

When we examine the change in wait times by the days of the week, it is seen that the appointment examinations are less than the examinations without an appointment every weekday. In addition, it is observed that the highest wait time is on Monday and the lowest is Wednesday. While the wait time for processes without appointment does not vary greatly depending on the days of the week, it is relatively longer on Mondays and Fridays.

Table 1. Wait times by days

Days	With appointment			Without appointment			Significance test result (p value)
	Number of Exami-nations	Avg. Pt. Wait times (min)	Standard Deviation	Number of Exami-nations	Avg. Pt. Wait times (min)	Standard Deviation	
Monday	3,636,233	102.7	3430	8,238,357	104.6	4026	0.8097
Tuesday	3,103,107	86.6	2935	6,989,156	103.4	4025	p<0.001
Wednesday	3,040,956	83.6	3196	6,864,133	92.6	3709	0.0002
Thursday	2,877,275	87.9	3402	6,501,22	99.6	3909	p<0.001
Friday	2,823,955	85.5	3223	6,376,656	104.5	4164	p<0.001

3.2. Analysis of Wait Times by Days in Secondary Level Hospitals

The values of the same indicator for secondary level hospitals are shown in Table 2. Comparing the wait times for patients with and without appointment by days, no Mondays ($p>0.05$), while the wait times for patients without appointment on other days were significantly higher than those for patients with appointment ($p<0.001$).

When we examine the change in wait times in secondary level hospitals by weekdays, it is seen that the appointment examinations are less than the examinations without an appointment every weekday. It is seen that the highest wait time is on Monday and the lowest is Wednesday.

Table 2. Wait times in secondary and tertiary level hospitals by days

Days		With appointment			Without appointment			Significance test result (p value)
		Number of Exami-nations	Avg. Pt. Wait Times (min)	Standard Deviation	Number of Exami-nations	Avg. Pt. Wait Times (min)	Standard Deviation	
Monday	secondary level hospital	2,237,169	125.6	3266	5,479,602	130.3	4824	0.235
Monday	tertiary level hospitals	1,399,064	66	3676	2,758,755	53.4	1464	0.0002
Tuesday	secondary level hospital	1,856,270	106.7	2750	4,558,026	131.9	4802	p<0.001
Tuesday	tertiary level hospitals	1,246,837	56.7	3191	2,431,130	49.6	1787	0.0422
Wednesday	secondary level hospital	1,823,827	96.6	2669	4,470,504	117.7	4504	p<0.001
Wednesday	tertiary level hospitals	1,217,129	64.1	3852	2,393,629	45.5	1236	p<0.001
Thursday	secondary level hospital	1,719,084	105.6	3217	4,232,708	127.1	4737	p<0.001
Thursday	tertiary level hospitals	1,158,191	61.7	3660	2,268,514	47.8	1316	0.0002
Friday	secondary level hospital	1,754,084	102.6	3032	4,242,336	133.3	5004	p<0.001
Friday	tertiary level hospitals	1,069,871	57.5	3514	2,134,320	46.7	1372	0.0044

3.3. Analysis of Wait Times by Days in Tertiary Level Hospitals

The values of the same indicator for tertiary level hospitals are shown in Table 2.

Comparing the wait times for patients with and without appointment by days, the wait times for patients with appointment every day are significantly higher than those for patients without appointment ($p<0.001$).

3.4. Wait Times Analysis by Working Hours

Patient average wait times and standard deviation values for examination procedures by working hours are shown in Table 3.

Each time shows the one-hour interval. Since the polyclinic service does not start regularly at 8.00 a.m., which is the first working hour excluded from the data pre-processing phase, the examinations performed at this hour were not included in the table. Likewise, the examinations performed after 4.00 p.m. are excluded from the evaluation and are not included in the table. Thus, the data on regular polyclinic working hours when all health institutions have the highest workload can be seen in the table.

When we examine the change in wait times in tertiary level hospitals by weekdays, it is seen, unlike secondary level hospitals, appointment examinations are higher than the examinations without appointment every weekday. It is observed that the wait time is the highest on Monday with the highest number of examinations, and the lowest wait time is on Friday with the lowest number of examinations.

Table 3. Number of patients, who are examined at different hours during the day, and their average wait times

Hours	With appointment			Without appointment			Significance test result (p value)
	Number of Examinations	Avg. Pt. Wait Times (min)	Standard Deviation	Number of Examinations	Avg. Pt. Wait Times (min)	Standard Deviation	
9.00 a.m.	3,904,966	90.5	3419	8,603,082	85.6	3310	0.0354
10.00 a.m.	3,353,942	89	3599	7,295,392	87.8	3642	0.6146
11.00 a.m.	1,937,806	92.3	3582	4,629,629	101.4	4040	0.0086
12.00 p.m.	399,293	156	3815	1,159,557	201.2	6032	p<0.001
1.00 p.m.	2,479,963	75.9	2317	5,117,189	88.3	3477	p<0.001
2.00 p.m.	2,099,393	75.7	2556	4,895,073	94.6	4013	p<0.001
3.00 p.m.	1,119,238	94.1	3201	2,686,531	128.7	4929	p<0.001
4.00 p.m.	199,291	232.3	4993	635,238	325.3	7812	p<0.001

Comparing the wait times for patients with and without appointment by hours, there is no significant difference between wait times at 11.00 a.m. While the average wait times for patients with appointment from 9.00 a.m. to 10.00 a.m. were statistically higher than those for patients without appointment ($p<0.05$), the average wait time for patients without appointment was statistically higher ($p<0.001$) at other hours.

When we examine the change in wait times by hours of the day, it is seen that patients both with and without appointment are the longest waiting patients at 12.00 p.m. and 4.00 p.m. when the least number of patients is examined. At 9.00 a.m. and 10.00 a.m., patients without appointment are much more frequent. However, there is no significant difference in the wait times for patients with and without appointment at these hours.

3.5. Analysis of Wait Times by Working Hours in Secondary Level Hospitals

Patient average wait times for examination in the secondary level hospitals by working hours are given in Table 4.

Table 4. Number of patients, who are examined at different hours in the secondary and tertiary level hospitals during the day, and their average wait times

Hours		With appointment			Without appointment			Significance test result (p value)
		Number of Exami-nations	Avg. Pt. Wait Times (min)	Standard Deviation	Number of Exami-nations	Avg. Pt. Wait Times (min)	Standard Deviation	
9.00 a.m.	secondary level hospital	2,360,700	98.1	2544	5,552,715	104.7	3995	0.0107
9.00 a.m.	tertiary level hospitals	1,544,266	79.1	4431	3,050,367	50.4	1327	p<0.001
10.00 a.m.	secondary level hospital	2,017,808	95.7	2762	4,718,901	109.4	4393	p<0.001
10.00 a.m.	tertiary level hospitals	1,336,134	78.9	4581	2,576,491	48	1457	p<0.001
11.00 a.m.	secondary level hospital	1,188,809	107.1	3129	3,061,747	128.1	4862	p<0.001
11.00 a.m.	tertiary level hospitals	748,997	68.8	4202	1,567,882	49.5	1443	0.0002
12.00 p.m.	secondary level hospital	249,371	202.1	4404	840,212	252.8	7068	p<0.001
12.00 p.m.	tertiary level hospitals	149,922	79.9	2560	319,345	64.9	747	0.0522
1.00 p.m.	secondary level hospital	1,476,369	100.3	2743	3,261,005	109.8	4164	0.0065
1.00 p.m.	tertiary level hospitals	1,003,594	40	1483	1,856,184	49.4	1611	p<0.001
2.00 p.m.	secondary level hospital	1,283,752	101.8	2966	3,211,660	124.9	4851	p<0.001

Table 4. (Continued)

Hours		With appointment			Without appointment			Significance test result (p value)
		Number of Exami-nations	Avg. Pt. Wait Times (min)	Standard Deviation	Number of Exami-nations	Avg. Pt. Wait Times (min)	Standard Deviation	
2.00 p.m.	tertiary level hospitals	815,641	34.6	1719	1,683,413	36.1	1327	0.9751
3.00 p.m.	secondary level hospital	687,793	135.1	3903	1,848,259	165.8	5841	p<0.001
3.00 p.m.	tertiary level hospitals	431,445	28.04	1503	838,272	45.9	1541	p<0.001
4.00 p.m.	secondary level hospital	135,066	327.1	6017	507,909	369.2	8610	0.0771
4.00 p.m.	tertiary level hospitals	64,225	32.1	1028	127,329	155.8	3237	p<0.001

3.6. Analysis of Wait Times by Working Hours in Tertiary Level Hospitals

The values of the same indicator for tertiary level hospitals are shown in Table 4. Comparing the average wait times for patients with and without appointment by hours, there is no significant difference between the wait times from 2.00 p.m. to 3.00 p.m. While the average wait times for patients with appointment between 9.00 a.m., 10.00 a.m., 11.00 a.m. and 12.00 a.m. are statistically higher than those for patients without appointment ($p<0.05$), the average wait time for patients without appointment is statistically higher in other time intervals ($p<0.001$).

When we examine the change in wait times in tertiary level hospitals by hours of the day, it is seen that the examined patients with appointment wait longer than those without appointment before 1.00 p.m., and the patients without appointment wait longer after 1.00 p.m. The other notable point is that wait times in tertiary level hospitals are much shorter than in secondary level hospitals.

Our study includes detailed analyses of patients with and without appointment, taking into account the examination days and hours in addition to the level of hospitals where the service is provided. The literature has some examples that compare weekend admissions with weekdays [28–31]. However, as seen in our study, people's behavior is likely to change on different days of the week. The Monday syndrome following the Sunday break is the best known example of this. Changes in the behavior of patients as well as those of employees are likely. When we examine this approach, it is possible to see the changes in patient admissions and wait times. Comparing the wait times for patients with and without appointment by days, no significant difference was observed on Mondays ($p> 0.05$), while the wait times for patients without appointment on other days

were significantly higher than those for patients with appointment (p <0.001). As seen in the table 1, approximately one third of the patients (29.80%) are admitted to the hospitals on Mondays. Again, the highest average wait times for patients both with and without appointment is on Mondays (103 min. and 105 min.) The first weekday is notable in terms of hospital congestion and wait time. Tosi et al. found that the patients who are admitted the emergency department on Mondays were 12.2%, which is higher than the other days [32]. There is a need for a detailed research on both patients' and health workers' behaviors specific to Monday.

Wait times are short on Wednesday, which is the middle of the week. The other striking point is that the average wait time for patients without appointment on Fridays is similarly high (105 minutes). While patients with appointment are affected in the same way, the longer wait times for patients without appointment may be related to the last working day of the week, because employees who are getting ready for the weekend are likely to be more hesitant about accepting extra patients without appointment. As a result, there are differences at the beginning, middle and end of the week. This situation should be evaluated well, and the efforts to improve this should be carried out accordingly.

Comparing the wait times for patients with and without appointment are compared by days in secondary level hospitals, the wait times for patients without appointment are significantly higher every day than those for patients with appointment (p <0.001), similar to general wait times.

Comparing the wait times for patients with appointment by weekdays in the tertiary level, the wait times for patients with appointment are significantly higher every day than those for patients without appointment (p <0.001). The average wait time for patients with appointment varies between 58 and 66 minutes, and it is between 46 and 53 minutes for patients without appointment. It is unexpected situation for patients with appointment to wait longer, and new studies are needed to explain the reasons.

The distribution of the patients during the day and wait times led us to encounter quite striking findings (Table 4). The first 2 hours in the morning (from 9.00 a.m. to 11.00 a.m.) is the period when patients with and without appointment are most frequently examined. According to the appointment status, 47% of the total examinations are carried out by appointment and 45.4% without an appointment during these hours. In other words, almost half of the daily patients are concentrated at this time of day. Probably, the habits have not changed much and patients prefer to go to the clinic area and wait early even if they have an appointment. Comparing the wait times for patients without appointment by hours, there is no significant difference between wait times at 11.00 a.m. While the average wait times for patients with appointment between 09.00 a.m. and 10.00 a.m. are statistically higher than those for patients without appointment (p <0.05), the average wait times for patients without appointment are statistically higher in other time intervals (p <0.001).

A similar finding was found in a study conducted on patients admitted to the emergency clinic 33. As reported in this study, patient admissions to the emergency department peak at 10.00 a.m. The second, but the lower peak, is at 7.00 p.m. Again, this study reported that the highest rate of admission was on Fridays, and the lowest rate of admission was seen on Tuesdays and Wednesdays.

At first glance, we can think that these times when waiting times are long are the most crowded times in clinics. However, this is not the case. The crowds in hospitals continue to exist until the late hours, and may even be more in the late hours. Actually, the data which we obtained gives an insight into this situation. The average wait time is not high during the hours when the highest number of patients are examined.

Before the Health Transformation Program in Turkey which was put into effect

in the early 2000s, patients were struggling to be examined by lining up before hospitals during the nighttime even in the evening, where even the first ones to be examined were exposed to long wait times. The impact of the reform is clearly visible. Based on our findings, the average wait time for patients who are examined early is around 1.5 hours, regardless of whether they have an appointment or not. This demonstrates that the appointment system fails to cause a change in patient comfort at least in terms of those examined at this hour, while the system works.

Very few patients are examined at 12.00 p.m. (1.0% + 2.9% = 3.9%), but these are the longest waiting patients (156-201 minutes). This is an expected situation since polyclinics are known work routinely at lunch time and patients are not given an appointment. The patients who are cared for at this time are those examined by healthcare professionals who waive the lunch break, probably because these patients wait too long. Therefore, the frequency is low, but the wait time is long.

A similar situation is also valid for patients who are cared for at 4.00 p.m. Only 2.40% of the patients are left for examination at this hour. These are the longest waiting patients (232-325 min.). It seems that there is no tendency to examine patients at this late hour of the day. We can notice this from the extremely low number of patients (0.50%) with appointment. We can assume that only the patients who wait for a long time are cared for, as at lunchtime. On the other hand, the absence of a new examination record should not imply that the workload of physicians and other staff working in the outpatient clinic has decreased. It is also possible that the examination results of the patients who were examined in the previous days and on the same day before noon are evaluated, which will avoid new patients. Finally, we need to keep in mind that we should not expect a highly efficient pace later in a hard and tiring day.

When secondary level clinics are reviewed by the hours of the day (Table 4), a similar picture emerges. Again, the patients are concentrated in the first 2 hours of the day, and the patients who are examined at noon and late in the day constitute a small number of patients who wait for a long time. On the other hand, patients without appointment wait longer on average regardless of the time when they are examined.

In tertiary level clinics, the patient density rule in the first hours of the day does not change (Table 4). The average wait times for all patients are lower than at the secondary level. However, an interesting picture emerges at the tertiary level. As at the secondary level, the wait times for those who are examined at noon are not longer than other hours. At the end of the day, only the patients without appointment seem to wait for a long period (155 minutes). Comparing the wait times for patients with and without appointment, the average wait time for the patients who are examined by appointment in the first half of the day (from 9.00 a.m. to 12.00 a.m.) is longer, whereas the patients who are examined without appointment in the second half of the day (from 1.00 p.m. to 4.00 p.m.) wait longer.

When the number of examinations and wait times are evaluated by hours of the day, it is understood that there is a more controlled patient management in tertiary level hospitals due to the stable distribution of patient rates by hours, close wait times and relatively shorter wait times. As mentioned above, the patients with appointment are exposed to longer wait times in the first half of the day, and we can attribute this situation to the fact that the habits before the Health Transformation Reform have not changed yet. It is likely that these patients prefer to come to the hospital early, while their appointment hours are fixed. The controlled management in tertiary hospitals may result from the long examination intervals and the examination of patients without appointment, who replace those not present at their appointment. Along with the patients with appointment, the factors such as control and evaluation of the test result make it difficult to accept patients without an appointment in

the afternoon, causing patients without appointment to wait longer.

CONCLUSIONS

It is globally recognized that patients should not be exposed to long wait times in a well-planned healthcare delivery system. Long wait times lead to patient dissatisfaction, inefficient use of resources, and complexity within the hospital. Additionally, this complexity makes process management difficult. It is important to identify bottlenecks to manage the process well. Using actual data, this study analyzed the wait times in Turkish public hospitals within the Centralized Physician Appointment System (CPAS). Based on the results of the analysis, it is determined that there is a pattern of congestion and wait times by the days and hours of the week. Since the data of 26 provinces are used in the study data according to the NUTS-2 regional classification, the study findings can be generalized to the whole Turkey.

This study, where the wait times within the national appointment system are discussed extensively and analyzed by hours and days in public institutions, is one of the rare studies in the world. The results are unique in that they fill a gap in an area where no previous study was conducted. The results of this study present analytical results for decision makers to optimize resources.

For further studies, an individual analysis of the wait times by clinics, provinces or laboratory and imaging procedures may yield notable results. Considering the findings of this study together with the proposed studies in the future, a more specific assessment can be carried out.

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