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Original Article

Factors that influence the attendance of patients at their allocated time slots in the thoracic surgery department: a cross-sectional study based on a hospital information system

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Abstract: Background: The appointment system has become the main way of outpatient service, and patients' arrival in accordance with the appointment time has become the key to ensure the efficiency of medical service. This paper systematically identifies the key factors affecting patients' timely arrival, which has practical significance for the intervention of appointment arrival rate. Methods: Information of patients in the Thoracic Surgery Department from the 1st of January 2019 to the 31st of December 2019, was extracted from the HIS (Hospital Information System) system of West China Hospital. Data relating to 29,337 patients were analyzed to form a cross-sectional study. Results: Univariate analysis showed that day of the week, booked time slots, booking method, type of payment, status of visit, gender, and place of departure were all related to early arrival of patients. Multivariate analysis showed that day of the week for the visit {Thursday [*OR = 1.261, 95% CI (1.098, 1.449)*]; Saturday [*OR = 1.257, 95% CI (1.067, 1.479)*]}, booked time slot {Afternoon [*OR = 0.602, 95% CI (0.558, 0.650)*]}, level of specialist [*OR = 1.072, 95% CI (1.032, 1.114)*], booking method {Self-service machine [*OR = 1.470, 95% CI (1.005, 2.152)*]}, gender {Women [*OR = 1.133, 95% CI (1.060, 1.210)*]}, place of departure {Within Chengdu [*OR = 0.756, 95% CI (0.684, 0.835)*]; Outside Sichuan Province [*OR = 1.235, 95% CI (1.115, 1.369)*]}, type of payment {Medical insurance [*OR = 1.263, 95% CI (1.111, 1.435)*]}, status of visit {Return visit [*OR = 1502, 95% CI (1.398, 1.435)*]}, appointment days in advance [*OR = 0.979, 95% CI (0.971, 0.987)*], and age [*OR = 1.009, 95% CI (1.007, 1.011)*] were significant factors that influenced the early arrival of patients *(P < 0.05)*. Conclusion: The early arrival of patients at allocated time slots is affected by multiple factors. Therefore, these factors should be considered carefully so that we can propose solutions to improve patient compliance.

Keywords: Outpatient, allocated time slots, early arrival, influencing factors

Introduction

Normally, patients are given allocated time slots in the hospital environments so that they attend their examination and treatment within the booked time slot [1, 2]. Booking medical visits in allocated time slots enables patients to have a better medical experience as this practice permits clinical data to be summarized and analyzed efficiently. This is also an important method by which to improve the outpatient department environment, reduce congestion, reduce waiting times, and allocate medical resources more efficiently [3]. According to hospital management regulations and appointment rules, time slots are usually half an hour. Over recent years, the proportion of booked outpatient registrations at hospitals in China has gradually increased, although certain phenomena are still prominent in large-scale general hospitals, including concentrated visiting times in the outpatient department, the uneven flow of patients, and noisy circumstances [4-6]. To further improve patient visits in the outpatient department and improve the patient experience, it has become necessary to develop new measures to direct large-scale general hospitals to allocate accurate time slots for

patients based on appointment booking systems [7]. The relevant key work program issued by the China National Health and Family Planning Commission (2019) also clearly highlights that it is necessary to effectively reduce the waiting time of patients by accurately estimating the visiting time.

Accurate estimation of the visiting time depends largely on the patients themselves; nonpunctual arrival can have a clear negative impact on the appointment system [8]. Whether patients see a doctor within the booked time slot can be influenced by a range of demographic factors, such as age and educational level [9]. When patients make appointments, data related to the correlation between these demographic factors and patients' visits within the specified time period can be used to proactively provide patients with a more efficient visiting time [10].

In this study, we used hospital data to identify the factors that affect the arrival of patients at their outpatient's appointments, provide an accurate basis for a service plan for patient arrival, and provide a basis for nursing field management.

Background

At present, most hospitals in China have implemented appointment booking systems and promote visits in allocated time slots [11]. There are two ways for patients to make an appointment. One is with an offline self-service machine; the other is with an online application. Self-service machines are usually set up in hospitals and connected hospitals [12]. When patients have questions about the appointment procedure, the hospital's service desk is available for them to make inquiries. As for the latter, it is more convenient for patients to download the APP on their phone, register and authenticate according to a dedicated process, and then make an appointment. However, the actual implementation and practice of these systems are not efficient [13]. It is still relatively common to see that patients arrive at the hospital in advance, stay in the outpatient department for a long time, and congest the waiting environment [14]. This not only makes it difficult to manage the waiting environment; it also directly affects the visit experience and patient satisfaction [15, 16]. Existing literature relating to this topic mainly focuses on increasing the proportion of booked registrations, the factors that influence patients missing their outpatient appointments, and other aspects [17]. There has been no research relating to the actual implementation of visits at allocated time slots in large-scale general hospitals in China. Therefore, in this study, we used the Thoracic Surgery Department of our hospital as an example, explored factors related to the early arrival of patients based on outpatient data from the HIS system [18], and put forward some solutions targeting the major influencing factors to better guide patients to visit the hospital according to the booked time slots. We also provide references and examples for the enhancement of the outpatient department environment, the improvement of patient satisfaction, and the reasonable allocation of resources at the outpatient department.

Methods

Design

This was a cross-sectional study using HIS data from the Department of Thoracic surgery outpatient clinics in a general hospital in southwest China.

Source of materials

Information from all patients who visited the Thoracic Surgery Department of our hospital from the 1st of January 2019 to the 31st of December 2019, was extracted from the information center of our hospital, including the following three types of data: (1) basic patient information including gender, age, and place of departure (within Chengdu, outside the city but within the province, and outside Sichuan Province); (2) registration information including booking method, booked time slot, and day of the week for the visit; and (3) visiting information including the level of the specialist, first or return visit, and arrival status (normal, early, and late). According to the check-in and registration time at the nurse's station, arrival within the booking time slot was defined as normal arrival, arrival earlier than the booking time slot was defined as early arrival, and arrival later than the booking time slot was defined as late arrival. Further details are shown in **Figure 1**.

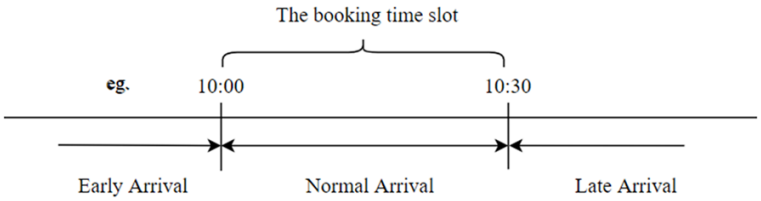

Figure 1. Clarification of arrival status.

Ethical considerations

This study was approved by the Ethics Committee of the West China Hospital Review Board for the protection of participant rights (2020-740). Patients who met the inclusion criteria were enrolled by their clinicians. To protect the interests of each patient, the research purpose, methods and procedures of this study were explained to each patient and, before the informed consent form was signed, each subject was informed that he/she could withdraw from the study at any time and that such a decision would not affect his/her treatment or care. The entire process was anonymous. Information was collected for academic research only and personal information was never disclosed.

Data preprocessing

There were 29,337 patients treated in the Thoracic Surgery Department during the study period. The patient's ID card number was taken as the only variable; data relating to patients with repeated visits, with a "foreign" origin, and with an "unknown" origin was excluded; the marital status variable was deleted (there was an overly high percentage of missing data; 60.1%). As a result, a total of 19,581 valid medical data were retained.

Statistical processing

Data were statistically analyzed using SPSS 21.0 software. Numerical data are expressed as numbers and percentages while measurement data are expressed as mean ± standard deviation. Comparisons of numerical data between groups were performed with the chi-squared test while the comparison of measurement data between groups was performed using the rank-sum test. Logistic regression analysis was used to explore the factors that influenced early arrival. $P < 0.05$ indicated statistical significance.

Results

Basic patient data

The mean age of the subjects was 52.27 ± 4.45 years and the mean number of appointments per day that were made in advance was 10.76 ± 14.32. A total of 9,422 males and 10,159 females were included; 5,494 (28.06%) arrived according to the booked time slot, 11,665 (59.57%) arrived early, and 2,422 (12.37%) arrived late.

Univariate analysis of early arrival

A total of 19,581 patients with normal arrival and early arrival were selected and the two groups were compared according to each variable. The results are shown in **Table 1** and **Table 2**. The results revealed that there were statistically significant differences in early arrival rate with respect to different days of the week for the visit, booked time slot and booking method, type of payment, place of departure, gender, and level of the specialist ($P < 0.05$).

Multivariate analysis of early arrival

Whether the patient arrived on time was taken as the dependent variable (assignment: 0 = visit during the booked time slot; 1 = visit earlier than the booked time slot). The variables with statistically significant differences in the univariate analysis were then taken as independent variables. Then we established a logistic regression model and used stepwise regression to screen the independent variables. The results showed that the day of the week for the visit, booked time slot, level of specialist, booking method, gender, place of departure, type of payment, status of visit, number of days to make an appointment in advance, and age, were all factors that influenced patient visits earlier than the booked time slots.

The possibility of early arrival on Thursday and Saturday was 1.261-fold and 1.257-fold higher than that on Monday. The possibility of early arrival in the afternoon was 0.602-fold that in the morning, and patients were more likely to visit earlier than the booked time slots in the morning. With a more senior specialist, the possibility of early arrival was 1.072-fold higher.

Table 1. Univariate analysis of early arrival (χ^2 test results)

Item	Arrival				χ^2 value	*P* value
	Normal arrival	Percent	Early arrival	Percent		
Gender						
Male	2514	30.05%	5851	69.95%	28.936	< 0.001
Female	2980	33.89%	5814	66.11%		
Place of Departure						
Within Chengdu	2902	37.59%	4818	62.41%	214.987	< 0.001
Within Sichuan Province	1838	26.36%	5134	73.64%		
Outside Sichuan Province	754	30.56%	1713	69.44%		
Day of the week for the visit						
Monday	1365	33.01%	2770	66.99%	58.166	< 0.001
Tuesday	989	34.91%	1844	65.09%		
Wednesday	1082	27.44%	2861	72.56%		
Thursday	963	34.23%	1850	65.77%		
Friday	653	31.21%	1439	68.79%		
Saturday	442	32.91%	901	67.09%		
Booked time slot						
Morning	2743	37.66%	4541	62.34%	184.947	< 0.001
Afternoon	2751	27.86%	7124	72.14%		
Booking method						
Online APP	3396	33.44%	6760	66.56%	90.367	< 0.001
WeChat	1365	32.89%	2785	67.11%		
Window	344	31.05%	764	68.95%		
Telecommunication 114	238	23.13%	791	76.87%		
Booking for diagnostic room	88	19.09%	373	80.91%		
Self-service machine	63	24.71%	192	75.29%		
Level of specialist						
Attending doctor	803	33.54%	1591	66.46%	10.668	0.014
Associate professor	742	29.62%	1763	70.38%		
Level 4 specialist	723	33.24%	1452	66.76%		
Level 1 specialist	3226	32.66%	6859	67.34%		
Type of payment						
Cash	5026	31.40%	10979	68.60%	41.419	< 0.001
Medical insurance	468	40.55%	686	59.45%		
Status of visit						
First visit	3322	28.68%	8262	71.32%	182.806	< 0.001
Return visit	2172	38.96%	3403	61.04%		

Table 2. Univariate analysis of early arrival (rank-sum test results)

Item	Unit	Arrival	Mean rank	*Z value*	*P* value
Age	year	Normal arrival	8156.77	-7.683	< 0.001
		Early arrival	8779.33		
Number of days to make an appointment in advance	day	Normal arrival	9031.05	-8.675	< 0.001
		Early arrival	8367.57		

The possibility of early arrival for female patients was 1.133-fold higher than that for male patients. For each additional year of patient age, the likelihood of early arrival

Table 3. Estimated parameter results derived from a logistic regression model for early arrival

Factor	*B*	*S.E.*	*Wald*	*P value*	*OR* value	*OR* value 95% *CI*	
						Lower	Upper
Day of the week for the visit							
Monday					1.000		
Thursday	0.232	0.071	10.802	0.001	1.261	1.098	1.449
Saturday	0.228	0.083	7.532	0.006	1.257	1.067	1.479
Booked time slot							
Morning					1.000		
Afternoon	-0.507	0.039	172.539	< 0.001	0.602	0.558	0.65
Level of Specialist	0.07	0.02	12.573	< 0.001	1.072	1.032	1.114
Booking method							
Online APP					1.000		
WeChat	-0.365	0.15	5.909	0.015	0.694	0.517	0.932
Window	-0.332	0.152	4.774	0.029	0.717	0.532	0.966
Self-service Machine	0.386	0.194	3.938	0.047	1.470	1.005	2.152
Gender							
Men					1.000		
Women	0.125	0.034	13.652	< 0.001	1.133	1.06	1.21
Place of Departure							
Within Sichuan Province					1.000		
Within Chengdu	-0.280	0.051	30.109	< 0.001	0.756	0.684	0.835
Outside Sichuan Province	0.211	0.052	16.227	< 0.001	1.235	1.115	1.369
Type of Payment							
Cash					1.000		
Medical insurance	0.233	0.065	12.819	< 0.001	1.263	1.111	1.435
Status of Visit							
First visit					1.000		
Return visit	0.406	0.037	123.532	< 0.001	1.502	1.398	1.613
Number of Days to make an appointment in advance	-0.021	0.004	26.548	< 0.001	0.979	0.971	0.987
Age	0.009	0.001	56.597	< 0.001	1.009	1.007	1.011

increased by 1.009-fold. The possibility of early arrival for patients who booked using self-service machines was 1.470-fold higher than that for patients who booked using the APP online. The possibility of early arrival for patients outside Sichuan Province was 1.235-fold higher than that for patients within Sichuan Province. The possibility of early arrival for patients who paid by medical insurance was 1.263-fold higher than that for patients who paid in cash. The possibility of early arrival for patients for return visits was 1.502-fold higher than that for patients attending their first visit. In addition, the shorter the number of days to make an appointment in advance, the higher the possibility of the patients visiting earlier. Further details are shown in **Table 3**.

Discussion

The precise implementation of hospital visits in allocated time slots is a relatively new concern and the public has poor awareness of the importance of attending their hospital visits in allocated time slots, thus leading to poor compliance and a clear phenomenon related to early arrival. Therefore, this study analyzed the influencing factors on the early arrival of patients and put forward some solutions and improvement strategies.

We found that the more senior the specialist patient was registered with, the higher the possibility that the patient would arrive early; this may be related to the great demand for senior specialists, the shortage of available registrations, the complexity of diseases, and disease-related anxieties. The reason why patients are more likely to arrive early on Thursday and Saturday than other days of the week may be related to the fact that more senior specialists are available for visits on Thursday and Saturday is a weekend, a time when patients have more free time. These results are consis-

tent with those reported previously by Gao et al. [19]. Therefore, hospitals should avoid arranging senior specialists or specialists with higher booking registration numbers to be available for visits on the same day of the week. Visit dates can be distributed in a more appropriate manner, the division of time slots for visits on weekends can be adjusted, and the registration numbers for different time slots can be allocated more precisely [20].

We also found that patients are more likely to arrive early in the morning, and for return visits patients are more likely to arrive early than patients on their first visit. This may be related to the fact that patients need to undergo examinations and spend more time on health insurance issues [21]. Under the background of the tiered treatment policy in our country, the following options could solve this problem. The general outpatient departments of large-scale public hospitals should redirect patients to lower-tier hospitals [22]. Hospitals should establish regional medical alliances to realize homogenous examinations, mutual recognition of examination results, and the mutual sharing of electronic medical records [23]. Patients returning for further visits should be guided to their nearest hospital for examinations to avoid flocking to large-scale hospitals and alleviate the "morning peak" situation.

With regards to the patients themselves, the possibility for early arrival for those who booked using the self-service machine was higher than that of patients who booked using the online APP. For each additional year of patient age, the likelihood of early arrival increased by 1.009-fold. This phenomenon is known to be more common in patients with a low level of education and older age [24]; these people lack understanding of online procedures and have a weaker perception of visiting during allocated time slots. Therefore, for these patients, the registration system needs to be further optimized to make the system automatically arrange the registration numbers with earlier visiting times. Alternatively, the patients should be allowed to choose time slots for visits independently and schedule the visit time appropriately so as to improve patient compliance with regard to attending the hospital during allocated time slots [25].

The reason why the patients outside Sichuan Province are more likely to arrive in advance while patients within the province are less likely to arrive in advance, may be related to the fact that patients from other provinces (outside Sichuan Province) need to arrive in advance due to their reduced knowledge of the procedures for visiting or that most of the patients from other provinces have refractory and severe diseases. This is consistent with findings reported previously [26]. Based on the implementation of tiered treatment, large-scale hospitals should take the initiative to cooperate with lower-tier medical institutions by setting up regional medical alliances and carrying out services such as fixed-point appointments, two-way referral, remote consultation, and technical assistance, to ensure that patients have access to multi-tier medical services in primary health-care units [27]. In addition, it is necessary to strengthen publicity relating to hospital visiting procedures the hospital and visits only during allocated time slots; this will help deduce patients from other provinces [28].

Patients who pay by medical insurance are more likely to arrive in advance than those who pay in cash; the reason for this may be related to the cumbersome procedures associated with medical insurance and because the settlement related to medical insurance needs to be carried out in advance. The solution is to optimize medical insurance procedures and combine online and on-site processing. Furthermore, the greater the farther out the appointment was made in advance, the less likely patients are to arrive early. In previous studies, patients who made appointments well in advance tended to miss the appointment at a higher frequency [29]. The patients who arrived for their visit after waiting for a long time may have been long-term follow-up patients who had developed fixed habits when visiting the hospital. In addition, patients who make their appointment in advance appear to show a better understanding of booking for a hospital visit and had better awareness of visiting during allocated time slots. Therefore, it can be considered that the system should automatically allocate registration numbers for later time slots for these patients and leave registration numbers at earlier times for patients who are more likely to arrive in advance. The other

solution is to optimize the rules of the booking system so that patients can choose the time slots for visits on their own.

Conclusion

There are many factors that can affect the working schedule of specialists and a patient's conscious decision to attend hospital appointments at the allocated time slots, thus promoting the early arrival of patients. Therefore, it is necessary to put forward solutions and improvement strategies according to each influencing factor so that we can optimize the concept of visits occurring only at allocated time slots. For example, hospitals should arrange the shifts of doctors in a balanced way according to the characteristics of each department and specialist clinic, the mean time period to be available for visits, and the complexity of different subspecialties [30]. Hospitals should also cooperate within regional medical alliances and promote tiered treatment strategies and the redirection of patients [31]. This will facilitate the mutual recognition of examination results and the exchange of electronic medical records, actively guide the development of internet-based hospitals and optimize the booking procedures for examinations and the handling procedures of social insurance. It is also necessary to optimize the rules for booking and registering and to use accurate methods to allocate time slots for visits in accordance with scientific and mathematical data, simulation analysis, and the subdivision of intervals between time slots. In addition, it is important to strengthen publicity relating to patients attending their specific allocated time slots. Multiple measures should be combined to improve the compliance of patients with regard to attending the hospital only during their allocated time.

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Disclosure of conflict of interest

None.

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