

# Who Misses Appointments Made Online? Retrospective Analysis of the Outpatient Department of a General Hospital in Jinan, Shandong Province, China

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**Purpose:** Missed appointments in outpatient registration pose challenges for hospital administrators, especially in the context of China's shortage of medical resources. Previous studies have identified factors that affect healthcare access via traditional appointment systems. Few studies, however, have specifically investigated Internet appointment systems. Therefore, this study explored the key factors related to missed appointments made on the Internet appointment system of a general hospital in Jinan, Shandong Province.

**Methods:** Online appointment data were collected from the outpatient department of a general hospital in Jinan from September 2017 to February 2018. Logistic regression was used to analyze the relative importance of eight variables: gender, age, interval between scheduling and appointment, day of the week, physician's academic rank, appointment fee, previous missed appointments, and clinical department.

**Results:** A total of 48,777 online appointment records were collected, which included a 15% no-show rate. The key factors associated with no-shows included age, interval between scheduling and appointment, previous missed appointments, and clinical department. No significant relationships were found between no-shows and gender, day of the week, and appointment fee.

**Conclusion:** No-show rates were influenced by many factors. Based on this study's findings, targeted measures can be taken to decrease no-show frequency and improve medical efficiency.

**Keywords:** online appointments, no-show appointments, influential factors, logistic regression

## Introduction

A "no-show" appointment is one that a patient misses without notifying the clinic or hospital that he or she will not attend the appointment. Patient no-show rates can range from 3% to 80%, depending on the patient population and the type of clinic.<sup>1,2</sup> No-show appointments can undermine planning, reduce access for others, and decrease efficiency, resulting in an underutilization of resources, which thereby raises costs, increases wait times, and decreases satisfaction.<sup>1,3,4</sup>

It is well known that "no-show" appointments are a serious problem in healthcare, especially in China, where medical resource tends to be scarce. For administrators in general hospitals, how to effectively utilize existing medical resources is a

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major challenge. As a major intervention mode in hospital resources, outpatient appointment systems significantly affect the efficiency of hospital services as well as patient experiences. Traditional outpatient registration methods—including manual window registration and telephone registration—have great defects in terms of timeliness and efficiency. With the application of information technology in the medical field—especially “Internet+medical” applications—online appointment systems have become a viable alternative that optimizes the appointment process. Online appointments greatly improve the efficiency of hospital services, reduce patient congestion, shorten wait times, and improve patient experiences.

Parmar et al found that online outpatient booking systems had a significantly better rate of attendance than traditional appointment methods, with a 17.8% no-show rate.<sup>5</sup> Habibi et al found that the no-show rate decreased from 25% to 11% after the introduction of an online appointment scheduling system.<sup>6</sup> Dusheiko et al also identified a reduction in no-shows with the use of online appointments.<sup>7</sup> Yet, the problem of no-show appointments has yet to be sufficiently resolved, despite the fact that various interventions have been introduced to reduce no-show rates, such as message reminders and temporary account suspensions.<sup>8–13</sup> Since no-shows are influenced by a number of factors, simple reminders or penalties cannot fundamentally solve the problem. Thus, for hospital administrators, identifying the key factors affecting no-shows is an important problem to solve.

Regarding the factors affecting no-show appointments, previous studies have identified factors such as forgetfulness, age, interval between scheduling and appointment, feeling better or worse, transportation problems, insurance issues, and gender.<sup>1,14–20</sup> However, such studies mainly focused on traditional appointment systems while few have considered online appointment systems. The present study, therefore, aimed to evaluate the factors affecting missed appointments using online appointment data from a general hospital over a 6-month period. Furthermore, by analyzing no-show variables, we aimed to extract the potential influencing factors to find a measurement to reduce the rate of missed appointments.

## Materials and Methods

### Data

The data contained the online appointment records of the outpatient department of a general hospital in Jinan,

Shandong Province, China, from September 2017 to February 2018. Traditional appointment records were excluded. The raw data were provided by Shunneng Network Technology Limited Company, who built the online appointment system for the hospital. The data included gender, age, interval between scheduling and appointment, day of the week, physician's academic rank, appointment fee, and clinical department. Identifying information (eg, resident identity card, telephone number) was excluded; incomplete records were excluded as well. The data also contained the outcomes of appointments—namely, cancellation or attendance. The number of previous no-show appointments for the hospital was also collected for the period January 2017 to August 2017.

This study was approved by the Academic Board of the School of Management, Science and Engineering, Shandong University of Finance and Economics (A-19-0089). At the same time, the Ethics Committee accordance with the principles stated in the Declaration of Helsinki approved the waiver of informed consent because of the following reasons. Firstly, we obtained the appointment records in this study from the data source in the Internet, and consent would be impossible or impracticable to obtain for such research. Secondly, the waiver of informed consent did not adversely affect the rights and health of the subjects. Thirdly, the privacy and data of the subjects are confidentiality. Finally, this study does not involve medical records that the subjects have explicitly refused before.

Use of the data was approved by Shunneng Network Technology Limited Company. And these data were permitted to access after authorization. Data were compiled using Microsoft Excel 2010.

## Statistical Methods

Descriptive statistical analysis was used to reveal the characteristics of different variables.

Univariate regression analysis was performed on all eight variables using SPSS 18.0 (SPSS Inc., Chicago, IL, USA). Multivariate logistic regression tests were conducted to illuminate potential correlations between the variables and missed appointments;  $p < 0.05$  was considered to be statistically significant.

## Results

### Description of Data

A total of 48,777 appointment records in the online appointment system were collected, including 7378 missed

appointments (15%); 465 incomplete records were deleted. Among the patients making appointments, 33,437 were female (68.55%), 12,569 had an appointment interval of 7–8 days (25.77%), and 38,366 had no record of a missed appointment before June 2017 (78.66%). Most patients (93.35%) used WeChat to make medical appointments while only 4.17% used the official hospital website. Among the no-show appointments, 4815 were female (65.27%), 4554 had an interval of 0–3 days (61.72%), and 4761 had no record of previous missed appointments (64.53%). Among the eight variables, higher no-show rates were observed among females (16.7%), below age 40 (14.52–19.38%), interval of 0–3 days (17.07%), Friday (16.47%), assistant professor, <10-yuan appointment fee (19.26%), other clinical departments (20.00%), and history of no-show appointments (20.62–43.54%). [Table 1](#) and [Figure 1](#) show the characteristics of the appointment records and no-show appointments.

## Logistic Regression

Univariate analysis showed that eight of the eight variables were statistically significant ( $p < 0.05$ ) (appointment fee were not significant). Then, multivariate logistic regression indicated that five of those seven variables remained statistically significant ( $p < 0.05$ ) (gender, day of the week, and appointment fee were not significant). [Table 2](#) shows the detailed results of the regression analyses. In the multivariate analysis, age was a key factor in missed appointments; the younger the patient, the greater the likelihood of a no-show. Patients with three or more previously missed appointments were more likely to be no-shows. Meanwhile, compared to patients with 0–6 days between scheduling and appointment, those with a 7- to 8-day wait were more likely to show up.

## Discussion

No-show appointments reduce healthcare efficiency. Therefore, understanding the factors associated with missed appointments is an important matter for hospital administrators.<sup>3,4</sup> Previous studies have associated factors such as age, insurance type, scheduling–appointment interval, and prior missed appointments with no-show appointment rates. Yet, there have been conflicting results with regard to variables such as age, gender, scheduling–appointment interval, and clinical specialty.<sup>1</sup> Furthermore, most previous studies were conducted in developed countries, making their findings less applicable to China. Today, with the widespread application of

Internet technologies, online appointments have become widely adopted. It is important, therefore, to investigate whether the factors affecting no-shows based on traditional appointment systems are the same as for Internet appointment systems.

In this study, the overall no-show appointment rate was 15%. Except for gender, appointment fee, and day of week, all other variables, as well as prior no-show history, influenced the occurrence of no-show appointments.

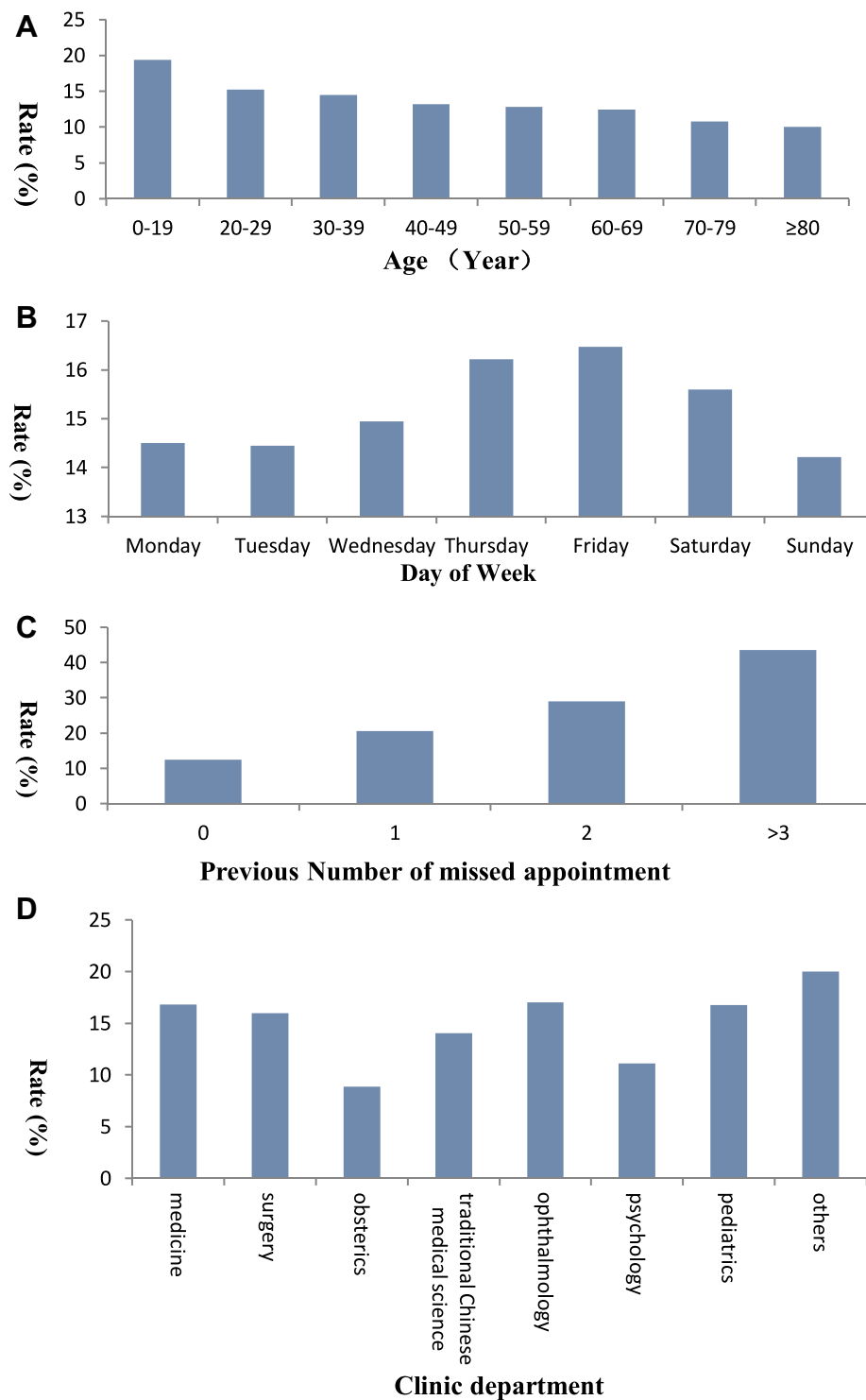
A prior no-show history has been widely recognized as the main influential factor in previous studies;<sup>1,21–23</sup> the same holds true for the present study. In our results, a patient with a record of no-show appointments had a sharply increased likelihood of not showing up. When previous no-show appointments increased from one to three or more, the patient was more likely to miss appointments (OR: 1.81 vs 5.02). This is consistent with Cronin et al (1.65 vs 3.62).<sup>18</sup> The main reason could be that missing appointments becomes habitual for some patients, who take missing appointments for granted.

Age is also potentially associated with increased no-show rates. In this study, age was found to be inversely proportional to the occurrence of no-shows. Patients aged 0–19 years had the highest no-show rate (19.38%) while those 60 and older had lower no-show rates, ranging from 10.05% to 12.43%. Logistic regression also indicated that age played an important role in no-show appointments—a finding that is similar to the results of most previous studies.<sup>1,24,25</sup> The primary reason could be that younger patients tend to miss appointments because of school, work, and family responsibilities. A secondary reason could be that younger people are more likely than older patients to make appointments online, which is consistent with Ganguli et al.<sup>26</sup>

In most previous studies,<sup>1,21,27,28</sup> scheduling–appointment interval was a strong predictor of no-shows; the greater the amount of time, the greater the risk of no-show. Cronin et al, for example, found that missed appointment rates increased with a longer wait between scheduling and appointment because of an increased likelihood of forgetting, among other reasons.<sup>18</sup> In our study, however, patients with a 7- to 8-day interval were less likely to miss appointments. One reason for this difference could have to do with interval length. In our study, the longest wait was 8 days; in Cronin et al and others<sup>21,27,28</sup>; however, scheduling–appointment intervals could exceed 21 days. Cohen et al found lower no-show appointment rates with intervals of 1–7 days compared to intervals of

**Table I** Characteristics of Missed Appointments Made on the Internet

Data Variables	Booked Population		p-value	No. of Missed Appointments (%)
	No. (%)	Missed Appointments (%)		
Gender				
Male	15,340 (31.45)	16.71	p<0.001	2563 (34.73)
Female	33,437 (68.55)	14.4		4815 (65.26)
Age group, years				
0–19	10,252 (21.02)	19.38	p<0.001	1987 (26.93)
20–29	9225 (18.91)	15.23		1405 (19.04)
30–39	15,369 (31.51)	14.52		2231 (30.24)
40–49	4534 (9.30)	13.17		597 (8.09)
50–59	4133 (8.47)	12.82		530 (7.18)
60–69	3828 (7.85)	12.43		476 (6.45)
70–79	1048 (2.15)	10.78		113 (1.53)
≥80	388 (0.80)	10.05		39 (0.53)
Interval days between scheduling and appointment date				
0–3	26,676 (54.69)	17.07	p<0.001	4554 (61.72)
4–6	9532 (19.54)	16.11		1536 (20.82)
7–8	12,569 (25.77)	10.25		1288 (17.46)
Day of the week				
Monday	8395 (17.21)	14.50	p<0.001	1217 (16.49)
Tuesday	8109 (16.62)	14.45		1172 (15.89)
Wednesday	7075 (14.50)	14.95		1058 (14.34)
Thursday	6657 (13.65)	16.22		1080 (14.64)
Friday	5870 (12.03)	16.47		967 (13.11)
Saturday	5943 (12.18)	15.60		927 (12.56)
Sunday	6728 (13.79)	14.22		957 (12.97)
Physician's academic rank				
Assistant professor	3172 (6.50)	19.26	p<0.001	611 (8.28)
Associate professor	19,510 (40.00)	14.61		2850 (38.63)
Professor	24,801 (50.85)	14.96		3711 (50.30)
Well-known professor	1294 (2.65)	15.92		206 (2.79)
Appointment fee (yuan)				
<10	3172 (6.50)	19.26	p<0.001	611 (8.28)
10–20	17,615 (36.11)	14.99		2641 (35.80)
20–50	26,696 (54.73)	14.68		3920 (53.13)
>100	1294 (2.65)	15.92		206 (2.79)
Previous missed appointments				
0	38,366 (78.66)	12.41	p<0.001	4761 (64.53)
1	7177 (14.71)	20.62		1480 (20.06)
2	1867 (3.83)	29.03		542 (7.35)
>3	1367 (2.80)	43.53		595 (8.06)
Clinical department				
Medicine	20,877 (42.80)	16.81	p<0.001	3509 (47.56)
Surgery	4706 (9.65)	15.98		752 (10.19)
Obstetrics	8557 (17.54)	8.86		758 (10.27)
Traditional Chinese medical science	5860 (12.01)	14.06		824 (11.17)
Ophthalmology	1474 (3.02)	17.03		251 (3.40)
Psychology	936 (1.92)	11.11		104 (1.41)
Pediatrics	2909 (5.96)	16.78		488 (6.61)
Others	3459 (7.09)	20.00		682 (9.38)



**Figure 1** The rate of missed appointment of different characteristics. (A) Age. (B) Day of week. (C) Previous number of missed appointment. (D) Clinic department.

7–15 days.<sup>29</sup> One reason could be that patients were anxious to visit doctors because of health issues, but they had difficulty making appointments for the type of disease or a specific doctor and were therefore more likely to make appointments further in advance.

Clinical specialty was also found to be an important determinant of no-shows. Dantas et al found physiotherapy having the highest median missed appointment rate (57.3%).<sup>1</sup> Meanwhile, examination clinics and pediatrics had the lowest median no-show rates.<sup>1</sup> Different from

**Table 2** Univariate and Multivariate Analyses of Missed Appointments

Variables	Univariate		Multivariate	
	OR (95% CI)	p-value	OR (95% CI)	p-value
Gender				
Male	1.192 (1.132–1.256)	p<0.001	1.00 (0.94–1.06)	0.863
Female	1 (Reference)		1 (Reference)	
Age group, years				
0–19	2.15 (1.54–3.01)	p<0.001	2.02 (1.44–2.83)	p<0.001
20–29	1.61 (1.15–2.25)	0.006	1.82 (1.29–2.55)	0.001
30–39	1.52 (1.09–2.12)	0.014	1.74 (1.24–2.44)	0.001
40–49	1.36 (0.96–1.91)	0.08	1.38 (0.99–1.95)	0.067
50–59	1.32 (0.93–1.86)	0.117	1.30 (0.92–1.83)	0.142
60–69	1.27 (0.9–1.79)	0.173	1.25 (0.88–1.77)	0.205
70–79	1.08 (0.74–1.59)	0.689	1.13 (0.77–1.66)	0.548
≥80	1 (Reference)		1 (Reference)	
Interval days between scheduling and appointment date				
0–3	1.80 (1.69–1.93)	p<0.001	1.47 (1.36–1.59)	p<0.001
4–6	1.68 (1.55–1.82)	p<0.001	1.42 (1.30–1.54)	p<0.001
7–8	1 (Reference)		1 (Reference)	
Day of the week				
Monday	1.02 (0.93–1.12)	0.635	1.084 (0.99–1.19)	0.093
Tuesday	1.02 (0.93–1.12)	0.692	1.09 (0.99–1.19)	0.089
Wednesday	1.06 (0.97–1.17)	0.225	1.09 (0.99–1.20)	0.089
Thursday	1.17 (1.06–1.28)	0.001	1.15 (1.05–1.27)	0.004
Friday	1.19 (1.08–1.31)	p<0.001	1.15 (1.04–1.27)	0.008
Saturday	1.11 (1.01–1.23)	0.03	1.09 (0.99–1.21)	0.093
Sunday	1 (Reference)		1 (Reference)	
Appointment fee (yuan)				
<10	1.26 (1.06–1.50)	0.009	1.032 (0.86–1.68)	0.736
10–20	0.93 (0.80–1.09)	0.368	0.98 (0.83–1.15)	0.79
20–50	0.91 (0.78–1.06)	0.221	1.00 (0.85–1.18)	0.99
>100	1 (Reference)		1 (Reference)	
Previous missed appointment				
0	1 (Reference)			
1	1.83 (1.72–1.96)	p<0.001	1.81 (1.69–1.93)	p<0.001
2	2.89 (2.60–3.21)	p<0.001	2.73 (2.45–3.03)	p<0.001
>3	5.44 (4.87–6.08)	p<0.001	5.02 (4.48–5.62)	p<0.001
Clinic department				
Medicine	1 (Reference)		1 (Reference)	
Surgery	0.94 (0.86–1.03)	0.168	1.05 (0.96–1.15)	0.280
Obstetrics	0.48 (0.44–0.52)	p<0.001	0.57 (0.51–0.63)	p<0.001
Traditional Chinese medical science	0.99 (0.90–1.02)	0.965	0.80 (0.71–0.90)	p<0.001
Ophthalmology	0.81 (0.75–0.88)	p<0.001	0.788 (0.72–0.86)	p<0.001
Psychology	1.02 (0.88–1.17)	0.827	1.07 (0.92–1.23)	0.382
Pediatrics	0.62 (0.50–0.76)	p<0.001	0.69 (0.56–0.85)	p<0.001
Others	1.24 (1.13–1.36)	p<0.001	1.32 (1.20–1.47)	p<0.001

Dantaset al,<sup>1</sup> ophthalmology department had higher no-show rates (17.01%) in our study while psychological consultation departments had the lowest (11.11%). One reason could be that ophthalmology is generally not related to serious, urgent health issues; thus, if a patient has other obligations, he or she might be more likely to miss an ophthalmology appointment.

Regarding gender, females were likely than males to make appointments online. However, logistic regression showed no relationship between gender and missed appointments. This finding aligns with Cronin et al<sup>18</sup> but differs from other studies. George et al<sup>30</sup> and Shabbir et al<sup>31</sup> found that females had a higher no-show frequency while Hamilton et al found that males missed more appointments.<sup>32</sup> It could be that the number of patients in some previous studies was too low to obtain accurate results. Our study and Cronin et al included 48,794 and 47,348 patients, respectively. Meanwhile, George et al<sup>30</sup> and Hamilton et al<sup>32</sup> included only 150 and 2078 patients, respectively.

Because of the existence of multicollinearity ( $r=0.92$ ) between appointment fee and physician's academic rank, only appointment fee was used in the multivariate analysis. As for the appointment fee, we did not examine the significant differences between the four types of appointment fee after the multivariate logistic analysis ( $p=0.239$ ). However, for physician's rank, assistant professors had higher no-show rates (19.26%) than well-known professors (15.92%) and professors (14.96%). There were significant differences among the four ranks in the univariate analysis ( $p<0.001$ ), which aligns with Fiorillo et al.<sup>19</sup>

Similar to previous studies,<sup>1,28,33</sup> we did not observe a significant association between day of the week and no-show rates. We did, however, find that missed appointment rates peaked on Fridays (16.47%), which is consistent with some studies<sup>1,34</sup> but different from Fiorillo et al, who found that Monday was the peak no-show day.<sup>19</sup> Further, while there were significant differences in the univariate analysis, none were observed in multivariate analysis.

This study has several limitations. First, we only selected data from a general hospital to explore the variables affecting no-show appointments. Differences in location, facility size, transportation convenience, and hospital reputation might all affect no-show appointments. Another limitation is that all of the data came from the online booking system, not from appointments made via traditional methods. Thus, we did not obtain relative patient information, including socioeconomic status, insurance

coverage, forgetfulness, the unavailability of transportation, and inability to get time off from work/school. These factors have been previously confirmed as common reasons for missing appointments. However, along with technological development, online appointment systems are now widely used in different hospitals, and reminder messages are now sent via mobile phones while traditional phone reminders are less common. Thus, it is necessary to analyze the association between object data in online systems and missed appointments.

## Recommendations

First, it is important to take measures to decrease no-show rates among patients with a history of missed appointments. We found a significantly positive association between no-shows and patients with a history of missed appointments, accounting for 21.3% of all no-show patients. For such patients, measures for decreasing no-show risk can include lengthening the interval between future appointments and previously missed appointments and sending more reminder messages via mobile phones.

Second, it is necessary to extend wait times or increase the number of appointments with long wait times to reduce no-shows for professors or well-known professors. We found that a 7- to 8-day interval had the lowest no-show rates compared to a 1- to 6-day interval. Thus, efficiency can be increased by extending the waiting intervals for certain clinical departments or for junior professors. At the same time, we also found an imbalance in online appointments, mainly involving the beginning and end of certain intervals, with few registrations in the middle. Thus, hospitals should take measures to change this imbalance by guiding patient registration via publishing messages online and arranging different numbers of online registrations at different stages.

Third, it is essential to reduce the waste of medical resources among certain clinical departments and for certain age groups. In our study, ophthalmology patients and those aged 0–39 had the highest no-show rates. Thus, measures should be taken to increase efficiency, including increasing the number of online appointments or manual window appointments.

Lastly, no-show rates could be decreased by strengthening publicity and education. In our study, most patients made appointments via WeChat. Therefore, publishing advertisements or reports on the hazards of no-show appointments via WeChat could help decrease no-show rates by educating the public.



## Conclusion

With the development of information technology, online appointment systems have become the primary means of healthcare-resource allocation. Missed appointments waste resources. Thus, how to rationally arrange medical resources online, target specific patient groups, and decrease no-show frequency are urgent problems for modern hospitals.

Through logistic regression analysis based on data from an online appointment system, we highlighted the diverse factors affecting no-shows and revealed the predictive value of patient age, history of missed appointments, time interval, and clinical department. Thus, considering these factors, hospital administrators need to take effective measures to decrease missed appointments and improve the use of healthcare resources. Such measures can include optimizing operational processes, extending the intervals between missed and future appointments, strengthening publicity and education through WeChat, and sending reminder messages to patients with a history of missed appointments.

## Ethics Approval and Consent to Participate

This study was approved by the Academic Board of the School of Management, Science and Engineering, Shandong University of Finance and Economics (A-19-0089).

## Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

## Disclosure

The authors declare that they have no competing interests.

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