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RESPONSIBLE EDITORS FOR THIS ISSUE

Observational Study

Effect and satisfaction of outpatient services by precision valuation reservation registration

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Abstract

BACKGROUND

Due to improvements in living standards, people are now paying more attention to their health. In China, more patients choose to go to large or well-known hospitals, which leads to constant crowding of outpatient clinics in these hospitals.

AIM

To establish precision valuation reservation registration aimed at shortening waiting time, improving patient experience and promoting the satisfaction of outpatients and medical staff.

METHODS

On the basis of the implementation of a conventional appointment system, more reasonable time intervals were set for different doctors by evaluating the actual capacity of each doctor to receive patients, and appointment times were made more accurate through intervention. The change in consultation waiting time of patients was then compared. Correlations between the consultation waiting time of patients and the satisfaction of patients or satisfaction of medical staff were analyzed.

RESULTS

After precision valuation reservation registration, the average consultation waiting time of patients reduced from 18.47 min to 10.11 min ($t = 8.90$, $P < 0.001$).

The satisfaction score of patients increased from 91.33 to 96.27 (t = -8.62, $P <$ 0.001), and the satisfaction score of medical staff increased from 90.51 to 96.04 ($t =$ -10.50, $P <$ 0.001). The consultation waiting time of patients was negatively correlated with their satisfaction scores (γ = -0.89, $P <$ 0.001). The consultation waiting time of patients was also negatively correlated with medical staff satisfaction scores (γ = -0.96, $P <$ 0.001).

CONCLUSION
Precision valuation reservation registration significantly shortened outpatient waiting times and improve the satisfaction of not only patients but also medical staff. This approach played an important role in improving outpatient services, provided a model that is supported by relevant evidence and could continuously improve the quality of management. Precision valuation reservation registration is worth promoting and applying in the clinic.

Key Words: Precision valuation reservation; Shorten waiting time; Effect on outpatient service; Satisfaction; Outpatients; Medical staff

Core Tip: Following precision valuation reservation registration, we obtained waiting times of patients and satisfaction scores of patients and medical staff. The average consultation waiting time of patients reduced and the satisfaction scores of patients and medical staff increased. The consultation waiting time of patients was negatively correlated with satisfaction scores. This approach played an important role in improving outpatient services, provided a model that is supported by relevant evidence and could continuously improve the quality of management.

INTRODUCTION

Due to improvements in living standards, people are now paying more attention to their health. In China, more patients choose to go to large or well-known hospitals, which leads to constant crowding of outpatient clinics in these hospitals[1,2]. The long existing phenomenon of "three long and one short"[3], long registration, medical treatment and payment queue waiting time, and the short time of seeing a doctor often cause anxiety in patients. The degree of satisfaction of seeing a doctor is reduced, and it can cause medical disputes[4-6]. It not only wastes patients' time but also reduces the efficiency of hospital management[7]. This problem exists internationally, and the World Health Organization has identified consultation waiting times for medical services as one of the key metrics in health systems[8]. Patient waiting time is the amount of time spent in a medical unit before consultation or treatment[9]. The British government has set a series of standards that require all patients to be seen within 30 min of an appointment[10]. To solve the phenomenon of three long and one short appointments, since 2009, China has called on major hospitals to adopt the mode of appointment, diagnosis and treatment[11]. Short waiting times and good order are important signs of modern hospitals[12]. Appointment, diagnosis and treatment can not only shorten the waiting time for consultation but also improve the order of outpatient services[13-15]. Therefore, the most effective measure is to carry out appointment, diagnosis and treatment. At present, most hospitals adopt the subperiod registration booking service, and the interval between the outpatient number is mainly 45-60 min[16]. The patient waiting time is still approximately 40 min, and the consultation waiting time remains long. Since 2017 and 2018, the medical clinic of a third-class hospital has been able to make a consultation within half an hour after

making an appointment; however, the monthly questionnaires still reflect the problem of long wait times for consultations. To better address this problem, precision valuation reservations have been used and fully documented since August 2018. This provides reliable results for clinical practice, further reduces the wait time for consultation, improves the satisfaction of patients and obviously improves the feeling of seeking medical treatment. It also enhances the satisfaction of medical staff.

MATERIALS AND METHODS

Methods

From January 2017-July 2018, serial number intervals were generally set at intervals of 5 min or 10 min.

From August 2018-February 2020, by evaluating the ability of each doctor to receive patients, information technology was used to set more reasonable intervals for different doctors to make the appointment times more accurate.

The specific methods were (1) Calculating the difference between the appointment registration time and the doctor's actual consultation time; (2) Monitoring doctors' real-time workload through information systems; and (3) Conducting a field investigation of outpatient visits by all physicians in the internal medicine clinic. Using the above methods, we mastered the outpatient consultation of each doctor. For example, some doctors had assistants and worked quickly, so in this case, the interval was set slightly shorter. Some older and experienced doctors had more patients with complications, so the interval was extended appropriately. Some diseases needed to be assessed by laboratory tests in the morning and diagnosed in the afternoon. Therefore, we set a shorter interval in the morning and a longer interval in the afternoon. After continuous evaluation, improvement and commissioning, each physician in the internal medicine clinic had a precision valuation reservation time tailored to them. There was no longer a general 5-min or 10-min reservation mode but multiple appointment intervals of 3, 4, 5, 6, 7, 8, 9 or 10 min. The working time was fully utilized, the diagnosis and treatment were more efficient and the wait time for consultation of patients was shortened.

Fifteen questionnaires prepared by the internal medicine clinic were distributed to patients daily (except holidays), and the patient satisfaction score was calculated. We used a Likert scale, and each statement had five responses: "Fully agree", "agree", "not necessarily", "disagree" and "very much disagree", which were recorded as 5, 4, 3, 2 and 1, respectively. The sum of scores with "very satisfied" and "satisfied" was divided by the sum of scores of all five scales ("very satisfied", "satisfied", "general", "dissatisfied", and" very dissatisfied"). This index was then multiplied by 100 to obtain a satisfaction score of which the highest score was 100.

Monthly questionnaires were distributed to all physicians and outpatient paramedics in the medical clinic, and the satisfaction score was calculated. We used a Likert scale, and each statement had five answers: "Fully agree", "agree", "not necessarily", "disagree" and "very much disagree", which were recorded as 5, 4, 3, 2 and 1, respectively. The sum of scores with "very satisfied" and "satisfied" was divided by the sum of scores of all five scales ("very satisfied", "satisfied", "general", "dissatisfied", and" very dissatisfied"). This index was then multiplied by 100 to obtain a satisfaction score of which the highest score was 100.

This research was approved by the Shandong Provincial Hospital Ethics Committee.

Evaluation methodology

We evaluated the consultation waiting time of advanced appointment patients, patient satisfaction and medical staff satisfaction from January 2017 to February 2020. Consultation waiting times were specific to the minute. The highest satisfaction score was 100.

Statistical methods

Differences in measurement data were compared by independent samples *t*-tests. The correlations between the consultation waiting time of patients and satisfaction of patients or satisfaction of medical staff were analyzed with linear correlation. The correlation coefficient (γ) ranges from -1 to 1. γ > 0 indicates a positive correlation, whereas γ < 0 indicates a negative correlation.

Table 1 Patients' consultation wait time before and after precision valuation reservation registration

Time	Number of appointments	Consultation wait time (min)
2017-01	7025	19.43
2017-02	9361	16.65
2017-03	10713	18.18
2017-04	10095	16.55
2017-05	11248	17.01
2017-06	10393	17.59
2017-07	10471	19.40
2017-08	12385	18.23
2017-09	10289	16.84
2017-10	10386	17.57
2017-11	10405	17.96
2017-12	11385	20.61
2018-01	12695	21.71
2018-02	10108	18.72
2018-03	14299	18.87
2018-04	12538	18.88
2018-05	14062	18.86
2018-06	13194	18.99
2018-07	13436	18.89
2018-08	14600	14.31
2018-09	11078	14.12
2018-10	13634	15.69
2018-11	13110	16.74
2018-12	13508	15.07
2019-01	14213	13.03
2019-02	11075	10.16
2019-03	15211	7.27
2019-04	14502	6.47
2019-05	15226	5.82
2019-06	13783	5.69
2019-07	15864	4.84
2019-08	15485	5.76
2019-09	14240	6.50
2019-10	14946	9.12
2019-11	14338	9.32
2019-12	15285	9.90
2020-01	11144	9.56
2020-02	2815	12.75

RESULTS

The wait times for consultations after precision valuation reservation registration were obviously shortened ($t = 8.90$, $P < 0.001$). Patients' consultation wait times before and

Table 2 Comparison of the mean wait time before and after precision valuation reservation registration

Time	Total appointments	Average wait time (min)	*t* value	*P* value
2017-01 to 2018-07	214488	18.47	8.90	< 0.001
2018-08 to 2020-02	254057	10.11		

after precision valuation reservation registration are shown in Tables 1 and 2.

Patient satisfaction significantly improved after precision valuation reservation registration (t = -8.62, P < 0.001). Patient satisfaction before and after precision valuation reservation registration is shown in Tables 3 and 4.

The correlation between patient consultation waiting time and patient satisfaction (Figure 1) was negative (γ = -0.89).

The satisfaction of medical staff was obviously improved (t = -10.50, P < 0.001). The satisfaction of medical staff before and after precision valuation reservation registration is shown in Tables 5 and 6.

The correlation between patients' consultation waiting time and the satisfaction of medical staff (Figure 2) was negative (γ = -0.96).

DISCUSSION

Long wait times are the main cause of patient dissatisfaction and reduce patients' satisfaction with hospital services. Even though hospitals provide free medical care, patients are less satisfied with their experience[17-19]. It is important not to waste patients' time and complete the matters related to their visit in the shortest possible time. By making full use of hospital information medical resources, the application of information systems can shorten the wait time for outpatient consultations, improve patient satisfaction and enhance the efficiency and quality of medical treatments[20-23]. In this study, the use of precision valuation reservation registration effectively shortened the wait time for patients' consultation, improved patient satisfaction, and greatly enhanced the patient experience. It also improved the efficiency and satisfaction of medical staff and enhanced the staff's work happiness[24].

Patients' registration time decreased to zero

Patients can make an appointment for a specific time using precision valuation reservation registration. They receive the corresponding information after the appointment is successful, and the reservation information clearly informs them of the specific time and place to sign in and pick up their number. Patients only need to arrive at the corresponding department to check in according to the specific time or sign in on their mobile phone. We need to enhance patient diversion in specialist clinics and avoid the peak of registration in the morning[25]. Precision valuation reservation registration solved the problem of patients' gathering in the morning at the outpatient clinic and solved the problem of a long registration queue. After using precision valuation reservation registration to make an appointment for a specific time, patients did not need to wait for registration.

Research showed that precision valuation reservation registration significantly reduced the wait time of patients

Wait time is an important factor influencing outpatient satisfaction[26-28]. According to reports[29], the average wait time for patients to visit specialist clinics in hospitals is more than one hour. If the appointment time is accurate to the hour, the wait time is still approximately 40 min on average. On the basis that the wait time in our hospital was steadily reduced to 30 min from January 2017-July 2018, we carried out precision valuation reservation registration in August 2018, and patients' wait time was reduced to 15 min or even within 10 min. The patients' wait time was further shortened, and the effect was remarkable.

Patients' satisfaction was improved

After precision valuation reservation registration was adopted, patient registration wait times and wait times after triage were almost zero. The patient arrived at the hospital, was checked in and could then hear a radio call. It effectively alleviated patient irritability and anxiety caused by long wait time. The number of medical

Table 3 Patient satisfaction before and after precision valuation reservation registration					
Time	Very satisfied[1]	Satisfied[1]	General[1]	Dissatisfied[1]	Very dissatisfied[1]	Satisfaction score
2017-01	130	127	21	5	2	90.18
2017-02	178	72	16	2	2	92.59
2017-03	160	140	25	5	0	90.91
2017-04	137	114	14	5	0	92.96
2017-05	187	83	26	4	0	90.00
2017-06	155	146	24	4	1	91.21
2017-07	151	160	29	2	3	89.21
2017-08	270	56	17	2	0	94.49
2017-09	205	90	12	8	0	93.65
2017-10	178	62	11	4	0	94.12
2017-11	157	144	22	6	1	91.21
2017-12	112	167	28	5	3	88.57
2018-01	127	162	36	3	2	87.58
2018-02	133	74	13	4	1	92.00
2018-03	162	122	26	5	0	90.16
2018-04	149	107	23	4	2	89.82
2018-05	159	143	22	3	3	91.52
2018-06	176	103	19	1	1	93.00
2018-07	172	132	22	2	2	92.12
2018-08	223	101	20	1	0	93.91
2018-09	200	70	12	3	0	94.74
2018-10	295	62	10	3	0	95.19
2018-11	207	102	17	2	2	93.64
2018-12	244	58	11	2	0	95.87
2019-01	241	75	12	1	1	95.76
2019-02	184	34	5	1	1	96.89
2019-03	262	31	6	1	0	97.67
2019-04	282	27	5	1	0	98.10
2019-05	281	15	3	0	1	98.67
2019-06	250	29	4	2	0	97.89
2019-07	289	48	7	1	0	97.68
2019-08	242	80	6	2	0	97.58
2019-09	231	60	9	0	0	97.00
2019-10	178	77	14	1	0	94.44
2019-11	230	72	12	1	0	95.87
2019-12	257	62	10	0	1	96.67
2020-01	201	34	5	0	0	97.92
2020-02	206	74	18	1	0	93.67

[1]The "Very satisfied", "Satisfied", "General", "Dissatisfied", "Very dissatisfied" columns in the table are the number of patients.

disputes was reduced to zero, and patients' were more appreciative. Although the

Table 4 Comparison of the mean satisfaction score before and after precision valuation reservation registration

Time	Copies	Mean satisfaction score	*t* value	*P* value
2017-01 to 2018-07	5775	91.31	-8.62	< 0.001
2018-08 to 2020-02	5730	96.26		

wait time of on-site appointment patients was still long, patients could also learn about the consultation time by the consultation waiting time on the registered ticket. Through our explanation, patients also knew that not making an appointment in advance was the reason for their long wait time for consultation, which reduced the tension, anxiety and dissatisfaction of patients. Patient satisfaction and the patients' sense of receiving medical attention were greatly improved.

The satisfaction of medical staff was improved, and the treatment was in good order

The patients registered at the designated place according to the appointment time. The incidence of medical disputes caused by the long wait time for consultation was reduced by considering the patient's own situation. It also eased the relationship between medical staff and patients and resulted in a peaceful and efficient treatment [30]. Precision valuation reservation registration basically achieved the effect of the patient's immediate visit after arriving at the hospital, so the treatment was in good order and the patient was not in a bad mood. It eliminated the time and effort of medical staff to maintain good order and even the abuse and dissatisfaction of patients. Precision valuation reservation registration saved the manpower of maintaining order, gave the medical staff time to provide health guidance to patients, greatly improved the medical staff's satisfaction with their work and enhanced their work happiness at the same time.

The sustainability of precision valuation reservation registration was ensured

At present, the reservation rate of our hospital has exceeded the 50% qualified rate set by the State Health and Family Planning Commission. To maintain or improve the reservation rate, we must improve the reservation awareness rate in various ways. Through questionnaires and on-site interviews, some patients were aware of the reservation. However, they did not know all the types of convenient reservations in the hospital. For example, some elderly patients said that they knew to make an appointment but did not know how to go online. This means that they did not know that they could make an appointment by telephone. As a result, the reservation was restricted. Therefore, we should increase the publicity for various reservation methods so that patients know the hospital provides suitable reservation services for all types of people. In addition to strengthening the publicity for reservations through the media, department staff should also make full use of patients' wait time to share information about reservations by making a video to explain how to make an appointment and playing the video intermittently. Department staff need to focus on the patients who need to return and who do not register on the spot successfully to explain the process. We should continuously improve the reservation rate, ensure the sustainability of precision valuation reservation registration and improve the patients' experience.

The waiting area of the outpatient clinic is where most patients spend most time during their visit, and its environmental comfort is particularly important for patients' experience[31]. Patients arrive at the hospital according to their appointment time, which effectively alleviates congestion in the waiting room. Patients previously had no place to wait before the hospital carried out reservations. After implementing precision valuation reservation registration, although the number of outpatients has increased year on year, patients have a place to wait, and even the walkway in the waiting room is not blocked now. It has obviously improved the environment, met the requirements for epidemic prevention and control, increased the environmental comfort of medical staff and patients and effectively alleviated the anxiety of medical staff and patients.

CONCLUSION

In summary, precision valuation reservation registration can significantly improve the effect of outpatient diagnosis and treatment and has achieved significant results. To

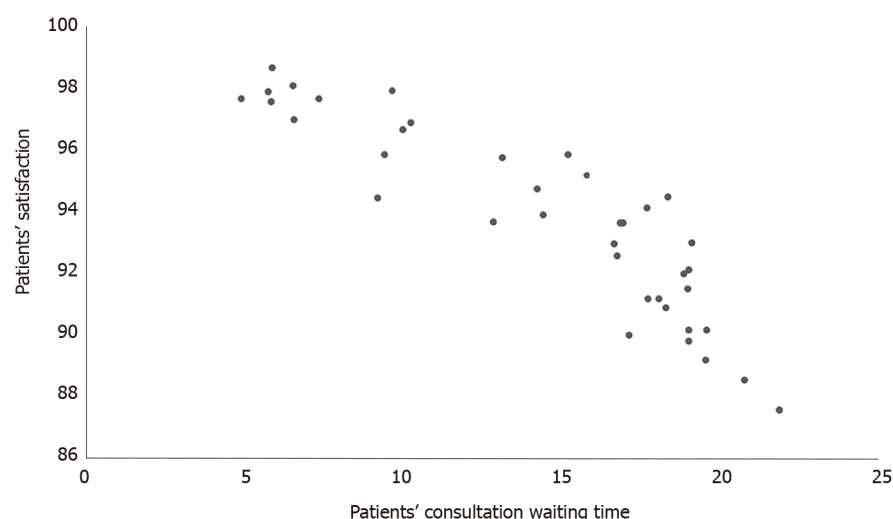**Table 5 Satisfaction of medical staff before and after precision valuation reservation registration**

Time	Very satisfied[1]	Satisfied[1]	General[1]	Dissatisfied[1]	Very dissatisfied[1]	Satisfaction score
2017-01	60	55	14	1	0	88.46
2017-02	74	43	10	1	0	91.41
2017-03	68	49	13	0	0	90.00
2017-04	77	42	10	0	0	92.25
2017-05	64	53	12	0	0	90.70
2017-06	69	49	10	1	0	91.47
2017-07	71	43	10	1	2	89.76
2017-08	69	45	12	0	0	90.48
2017-09	77	39	10	1	0	91.34
2017-10	68	47	12	0	0	90.55
2017-11	71	45	11	0	0	91.34
2017-12	55	58	14	0	1	88.28
2018-01	53	59	15	1	0	87.50
2018-02	67	47	12	0	0	90.48
2018-03	76	42	10	1	0	91.47
2018-04	79	40	9	1	0	92.25
2018-05	73	44	11	1	0	90.70
2018-06	63	53	12	0	0	90.63
2018-07	64	52	11	1	0	90.63
2018-08	84	35	9	0	0	92.97
2018-09	87	32	8	0	0	93.70
2018-10	87	32	8	0	0	93.70
2018-11	77	40	10	0	0	92.13
2018-12	102	27	7	0	0	94.85
2019-01	108	22	5	0	1	95.59
2019-02	119	12	3	1	0	97.04
2019-03	125	9	2	0	0	98.53
2019-04	120	14	3	0	0	97.81
2019-05	125	9	3	0	0	97.81
2019-06	124	11	3	0	0	97.83
2019-07	128	8	2	0	0	98.55
2019-08	124	10	3	0	0	97.81
2019-09	118	14	3	1	0	97.06
2019-10	110	20	6	0	0	95.59
2019-11	113	19	5	0	0	96.35
2019-12	115	24	5	1	0	95.86
2020-01	122	17	5	0	0	96.53
2020-02	112	25	6	1	0	95.14

[1]The "Very satisfied", "Satisfied", "General", "Dissatisfied", "Very dissatisfied" columns in the table are the number of patients.

consolidate the effect of precision valuation reservation registration, hospitals should

Table 6 Comparison of the mean satisfaction score of medical staff before and after precision valuation reservation registration

Time	Number of medical staff	Mean satisfaction score	*t* value	*P* value
2017-01 to 2018-07	2434	90.51	-10.50	< 0.001
2018-08 to 2020-02	2581	96.04		

Figure 1 Correlation between patients' consultation wait time and patients' satisfaction.
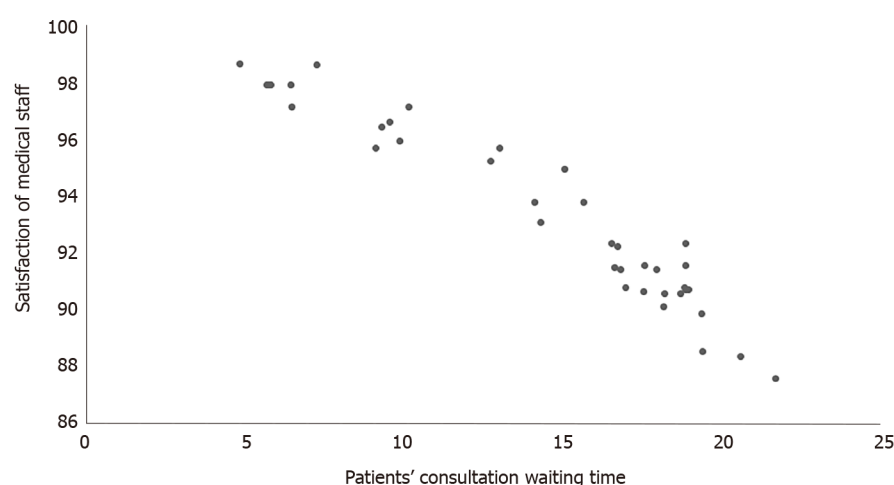
Figure 2 Correlation between patients' consultation wait time and satisfaction of medical staff.

increase the publicity and reservation awareness rate of patients. On the other hand, it is necessary to let patients know and experience the convenience of appointments so that they can pass this information on to others and raise their awareness of appointments. They could make an appointment when they return for a visit, and others could also benefit from appointments[32,33]. The study found that some patients, although booked, still arrived early. Therefore, hospitals should make full use of information to increase publicity on the spot and let patients arrive at the hospital according to their appointment time to save patients' time and reduce the effect of crowding. Therefore, hospitals should continue to strengthen publicity among patients, informing them once the appointment is successful that it has been sorted according to the timepoint selected and that there is no need to line up again in advance in the hospital. The hospital has also established strict management rules and regulations, such as an expert outpatient management system, formulated a reasonable outpatient leave and replacement system and strictly enforced it to reduce the rate of doctors' breach of contract and continuously improved the quality of

appointments. Doctors should be regularly inspected, supervised and assessed, and summaries should be timely. According to the information system, doctors who arrive early should be encouraged, and latecomers should be reminded of the comprehensive objectives of the department and informed through the office platform and other measures. This can effectively shorten the wait time for consultation, reduce disputes between doctors and patients, continuously improve patients' feelings of seeking medical treatment and continuously improve the satisfaction of medical staff and patients. Precision valuation reservation registration is worth popularizing in the clinic.

ARTICLE HIGHLIGHTS

Research background
Due to improvements in living standards, people are paying more attention to their health. In China, more patients choose to go to large or well-known hospitals, which leads to constant crowding of outpatient clinics in these hospitals.

Research motivation
To better address this problem, precision valuation reservations have been adopted. This system can provide reliable results for clinical practice.

Research objectives
To establish precision valuation reservation registration aimed at shortening waiting time, improving patient experience and promoting the satisfaction of outpatients and medical staff.

Research methods
Information technology was used to set more reasonable consultation time intervals for different doctors. Questionnaires on satisfaction were distributed to patients and medical staff to calculate the satisfaction score. Differences in measurement data were compared by independent samples t-tests. The correlations between consultation waiting time for patients and the satisfaction of patients or medical staff were analyzed with linear correlation.

Research results
The wait times for consultations after precision valuation reservation registration were obviously shortened. Patient satisfaction significantly improved after precision valuation reservation registration. The correlation between patient consultation waiting time and patient satisfaction was negative. The satisfaction of medical staff was obviously improved. The correlation between patients' consultation waiting time and the satisfaction of medical staff was negative.

Research conclusions
Precision valuation reservation registration significantly shortened outpatient waiting times and improved the satisfaction of not only patients but also medical staff.

Research perspectives
It is understood that this is the first study to reduce the wait time for outpatient consultations, improve patient satisfaction and enhance the efficiency and quality of medical treatments by setting personalized appointment intervals. This approach played an important role in improving outpatient services, provided a model that is supported by relevant evidence and could continuously improve the quality of management. Precision valuation reservation registration is worth promoting and applying in the clinic.

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