Zhang et al. BMC Health Services Research (2025) 25:701
https://doi.org/10.1186/s12913-025-12714-9

BMC Health Services Research

RESEARCH Open Access

Impact of expected waiting time on pediatric outpatient satisfaction: a behavioral experiment study

Hui Zhang[1†], Junhua Tian[2†], Yu Shi[3], Yuping Qian[3], Xuan Gao[3*] and Xiaowen Zhai[4*]

Abstract

Background Outpatient departments of tertiary children's hospitals in China are often overcrowded. This study used a behavioral experiment to investigate the relationship between expectations and satisfaction levels to improve visitor satisfaction.

Methods The experiment consisted of control and experimental groups. Initially, the initial expected waiting times (EWT) for the subjects in both groups were obtained. Unlike the control group, subjects in the experimental group received reminders regarding waiting times and subsequently adjusted their EWT accordingly. This study mainly used non-parametric tests to analyze the differences in satisfaction levels between the two groups of subjects. Ethical approval for this study was obtained from the hospital ethics committee.

Results Significant differences in satisfaction levels were observed between the control and experimental groups when AWT exceeded EWT. However, no significant disparity in satisfaction levels was observed between the two groups when the AWT was equal to or shorter than the EWT.

Within the experimental group, a significant difference in satisfaction was noted during peak hours between parents effectively regulated by the EWT and those not effectively regulated. Conversely, during off-peak hours, there was no significant difference in satisfaction between those effectively regulated by the EWT and those not effectively regulated.

Conclusion Providing advance notice of long waiting times can extend the EWT of the subjects and significantly enhance their satisfaction. Healthcare institutions can adjust the EWT of the visitors by informing them in advance about potential waiting times according to the temporal patterns of outpatient visitation numbers during peak hours.

Keywords Expected waiting time, Outpatients satisfaction, Behavioral experiment

†Hui Zhang and Junhua Tian are co-first authors.

*Correspondence:
Xuan Gao
xuangao@fudan.edu.cn
Xiaowen Zhai
xwzhai@fudan.edu.cn

[1]College of Shanghai Lausanne Hospitality Management, Shanghai Business School, Shanghai 200235, China
[2]Nursing Department, National Children's Medical Center, Children's Hospital of Fudan University, Shanghai, China
[3]Outpatient and Emergency Management Office, National Children's Medical Center, Children's Hospital of Fudan University, Shanghai, China
[4]Department of Hematology/Oncology, National Children's Medical Center, Children's Hospital of Fudan University, Shanghai, China

Introduction

Waiting occurs when the demand for a service exceeds its supply at a certain point in time. Moreover, the workflow [1] and physical infrastructure of a hospital [2] are also significant factors that result in long waiting times. In the field of consumer services, long waiting times negatively affect on customer satisfaction [3] and loyalty [4]. Patients often perceive waiting as a wasteful use of their time [5, 6]; long waiting times also affect patients' satisfaction in the medical services field [7], and even impact the physical recovery of the patient [8]. Even worse, extended waiting periods also increase the risk of acquiring infections within the hospital premises [9].

Patient satisfaction is a critical indicator of the quality of healthcare services [10–12]. Numerous studies have demonstrated that satisfaction levels decreases as waiting times increase. Medical institutions and scholars have made numerous efforts to reduce actual waiting times (AWT) and increase patients' satisfaction. Implementing online appointment registration has been suggested to significantly reduce the AWT of the patient [13]. The implementation of effective scheduling systems [14–17] and "Lean methodologies" [18] can also reduce patient AWT. However, during peak hours in hospitals, patient queues remain common. To reduce patient waiting times, an artificial intelligence-based automated medical history-taking system was implemented. However, in practice, there was no significant improvement in the waiting time for patients visiting the general internal medicine outpatient department without an appointment [19]. Medical institutions can reduce patient AWT by increasing infrastructure and hiring more staff [20]. However, during unpredictable special periods such as influenza outbreaks, the number of patients can increase significantly in a short period of time. Adding staff members is challenging to implement in practice.

In addition to reducing AWT, reducing the perceived waiting time (PWT) of the patient by enhancing the clinic environment can improve patient waiting experiences [21], it can help to alleviate the adverse effects of waiting [22]. For example, in the waiting areas of medical environments, adding natural elements such as green plants can reduce patient anxiety and positively impact their PWT [23]. Changes in the physical space of waiting areas can also influence waiting experiences of the patients. For example, by implementing a semi-automatic notification system, patients are afforded the option to await their consultation outside the hospital grounds, as the appointed consultation time approaches, this system dispatches a text message to recall the patient for their medical appointment, thereby enhancing the PWT experience [9]. Research has shown that different queuing strategies should be implemented during peak and off-peak hours to mitigate any discomfort experienced while waiting. businesses can improve customer satisfaction during peak hours by dividing the queue into multiple parallel lines, whereas, during off-peak hours, merging the queues can enhance satisfaction [24]. This indicates that different queuing formats have an impact on the PWT of the patient, which significantly affects patient satisfaction [25–27].

In addition to reducing AWT and PWT, adjusting the expected waiting time (EWT) is another strategy for improving the waiting experience. Research in the customer service field has shown that the same wait duration may impact customers differently. If the waiting time is shorter than expected, it results in satisfaction and comfort; if it is longer than expected, it triggers anxiety and dissatisfaction [28]. In the field of health services, patients who received information regarding how long they would have to wait and found ways to stay busy while waiting tended to be more satisfied with the emergency department [29]. Informing patients of the delay time in advance can help them adjust their EWT [30] and reduce their anxiety and uncertainty while waiting [31]. Therefore, complaints can be reduced [32]. However, in practice, hospital administrators may wonder to what extent adjusting the EWT of the patient can maximally enhance their satisfaction. Further study has shown that aligning an EWT of the patient more closely with the AWT increases satisfaction [33]. This finding provides a clear direction for hospital administrators to enhance patient satisfaction by adjusting EWT.

Previous research has provided valuable suggestions for improving the waiting experience, including reducing the AWT and PWT and adjusting the EWT. However, unlike adult outpatient departments, although parents accompanying their children do not experience physical discomfort, they may be more emotionally agitated because of concerns for their children, furthermore, the number of patients in hospital outpatient departments fluctuates significantly, especially in China's tertiary children's hospitals, where there is a significant increase in pediatric visits during the flu season and the summer vacation, leading to correspondingly longer wait times for pediatric patients and their parents. The above two reasons may lead to different behaviors and attitudes of pediatric patients' families when facing long waiting times compared to other environments. In addition, strategies for adjusting PWT during peak and off-peak periods have varying effects [24]. Therefore, we were also curious as to whether distinct peak and off-peak periods could significantly improve the satisfaction of pediatric visitors. Furthermore, to better test the application of theory in practice, unlike the aforementioned studies, in our experimental group, the announcements regarding waiting times during peak and non-peak periods are based on the AWT during peak and non-peak periods in the control group. This approach more accurately reflects the outpatient environment, allowing hospital administrators to better apply theory to real-world situations.

Based on the aforementioned issues, this study explored how visitors satisfaction is affected by adjusted EWT. Specifically, the research compared subjects satisfaction between the control and experimental groups in three scenarios: when the AWT exceeds the EWT, when the AWT aligns with the EWT, and when the AWT falls short of the EWT duration.

Furthermore, we investigated the variation in satisfaction levels among subjects in the experimental group during peak and off-peak visiting hours, after informing them of a longer wait time.

The innovative aspects of this study are primarily reflected in three areas. First, it aimd to provide a method to improve the waiting experience in pediatric hospitals. Second, it considers the joint impact of AWT and EWT on satisfaction when examining the influence of EWT. Third, the research separately studied the effects of informing subjects about waiting times in advance during peak and off-peak periods to enhance visitor satisfaction, aligning more closely with the practical needs of healthcare management.

Methods

Experiment design

The experiment was divided into two distinct groups: control and experimental. In the initial segment of the experiment, both groups underwent inquiries regarding the initial EWT, while capturing fundamental information such as age, education level, gender, and medical history. The distinguishing factor between the two groups was the implementation of waiting-time reminders. Following this intervention, the experimental group was provided with adjusted EWT information. This part of the experiment was completed upon the entry of the patient into the consultation room.

Outpatient visits in hospitals were divided into peak and off-peak periods based on the number of visits. Based on the number of patients, the peak hours of the hospital were from 8:31 to 11:00 in the morning and from 13:31 to 15:30 in the afternoon, except for off-peak hours. Referring to the AWT data from July, we used a median AWT of 30 min during peak hours and 16 min during off-peak hours as prognostic indicators for EWT within the experimental group.

Effective adjustment was defined as patients aligning their expectations to approximately 30 min after receiving information indicating a 30-min waiting time. As an illustration, if an individual initially expects a waiting time of 15 min and upon receiving information, adjusts the EWT to 40 min,, then the disparity between the initial EWT and the 30-min prompt message is 15 min, while the variance between the adjusted EWT and the prompt message is 10 min. The latter, which is more closely aligned with the timing of the prompt information, is regarded as an effective adjustment.

The subsequent part of the experiment, applicable to the control and experimental groups, was administered as the patients were on the verge of entering the consultation room with a designated number. This sequential approach aimed to capture real-time insights into the experiences and expectations of the subjects, enabling a thorough examination of the impact of waiting-time reminders on adjusted EWT and overall satisfaction. The control and experimental groups were assigned satisfaction scores corresponding to their AWT upon summoning. Satisfaction was gauged on a scale ranging from 0 to 100, with “0” denoting utmost dissatisfaction and “100” indicating maximum satisfaction. Higher scores indicated a heightened level of contentment. Since many subjects make online appointments and can settle registration fees through mobile payments, these pre-arrival tasks can be efficiently completed at home or en route to the hospital. Consequently, for the purposes of this study, AWT encompassed the temporal interval between the subjects’ check-ins and the subsequent time of entering consulting room.

The implementation schedule for this study involved the control group undergoing intervention in July 2023, whereas the experimental group experienced the same schedule in August 2023. This strategic timing was grounded in past observations, indicating a peak period of outpatient visits in pediatric hospitals during the summer months of July and August.

Experimental participants

The participants of this study were patients and their parents who visited the pediatric hospital of an endocrine clinic between July and August 2023. Our investigation was anonymous and self-managed by patients and their parents. The formula for sample size is expressed as follows: $n = \mathrm{Z}^2\mathrm{P}(1-\mathrm{P})/\mathrm{E}^2$, where n is the minimum sample size. Z is the normal standard deviation at a 95% confidence level (1.96), and P is the prevalence of the factor in the study, which was determined to be 80% based on previous studies [25].

Experimental implementation

The experiment comprised two steps. The initial segment was undertaken as soon as the subjects arrived in the waiting room, whereas the second part comprised a single question addressed when the subjects were summoned to the consultation room.

In the initial phase, during administration to the control group, subjects were presented with the first segment of the questionnaire upon signing in and entering the waiting area. The entire procedure, encompassing the explanation of informed consent, clarification of research objectives, and notification of completion guidelines, spanned approximately 6 min.

When subjects completed this part of the questionnaire, a staff member recorded their registration code, date of visit, and check-in time on the back of the paper. This part of the questionnaire was temporarily stored in the hands of subjects. The implementation of the experimental group was basically the same as that of the control group, with the only difference being that for subjects visiting during peak hours and off-peak hours, subjects will received information regarding possible waiting times during peak and off-peak periods when filling out the questionnaire, and patients and their parents were given corresponding adjusted EWT.

During the second phase, as subjects on the verge of entering the consulting room reached the entrance, staff members collected the initial segment of the questionnaire from the subjects. Subsequently, the staff member calculated the disparity between the entering to the consulting room and check-in times, representing the AWT. Inquiring about the satisfaction scores of the subjects in light of this AWT scenario, the staff member promptly recorded their responses. This segment of the questionnaire could be completed efficiently within one minute.

Variables

Demographic variables

The demographic variables included gender, age, hospital history, and education level.

EWT

Initial EWT: EWT that is not affected by time information interference.

Adjusted EWT: In the experimental group, the EWT was adjusted after information about the waiting time was obtained.

AWT

AWT was defined as the difference between the time of entering the consulting room and the time of check-in.

Satisfaction level

For the evaluation of satisfaction, subjects were asked to choose a score from"0" to "100" to represent their views at the time of the entering the consulting room, in which "0" means very dissatisfied, and "100" means very satisfied.

Ethical consideration

This study was conducted in accordance with the principles of the Declaration of Helsinki and was approved by the Research Ethics Committee of the Children's Hospital of Fudan University [No. (2023) 152]. Informed consent was obtained from all participants before experiment.

Statistical methods

Data analysis was carried out using IBM SPSS Statistics 22.0 software. Given the non-normal distribution of waiting time, Kolmogorov-Smirnov tests and Mann-Whitney *U*-tests for two samples were employed to scrutinize potential statistically significant differences in AWT, or satisfaction scores between the control and experimental groups. A p-value < 0.05 was considered to indicate a significant difference. Furthermore, Chi-square tests were used to assess variations in satisfaction levels between peak and off-peak hours, complemented by applying descriptive statistical methods.

Results

Baseline characteristics

In total, 2,020 subjects participated in the experiment overall, and one subject in the experimental group had missing key data. The effective sample size was 2,019, with 1,013 in the control group and 1,006 in the experimental group. A total of 666 (66.2%) and 729 (72.0%) subjects were females in the experimental and control groups, respectively (Table 1). The experimental and control groups comprised 637 (63.3%) and 677 (66.8%) aged between 18 and 36 years, respectively. 708 (69.9%) and 773 (76.8%) of the subjects in the experimental and control groups received college or undergraduate education, respectively. Most of the two groups of subjects have visited this hospital for treatment, with 891 (88.0%) subjects in the control group and 769 (76.4%) subjects in the experimental group.

Table 1 Basic information of the subjects

	Control group	Experimental group
Total	1,013	1,006
Gender		
Male	284(28.0%)	340(33.8%)
Female	729(72.0%)	666(66.2%)
Age		
Below 18 years old	4(0.0%)	0(0.0%)
Between 18–36 years old	677(66.8%)	637(63.3%)
Above 36 years old	332(32.8%)	369(36.7%)
Education		
High school or below	191(18.9%)	178(17.7%)
Diploma or undergraduate	708(69.9%)	773(76.8%)
Postgraduate	114(11.3%)	55(5.5%)
Visit history		
Yes	891(88.0%)	769(76.4%)
No	122(12.0%)	237(23.6%)

Impact of adjustment of EWT on satisfaction

Categorization of the subjects into control and experimental groups was performed by comparing their AWT (T_a) with the initially EWT (T_0). This classification yielded three distinct categories:

a. Subjects with Longer AWT than EWT (T_0-T_a< 0): This group was comprised of subjects whose AWT exceeded the initially EWT.
b. Subjects with Equal EWT and AWT (T_0-T_a= 0): The second category encompassed subjects whose initially EWT aligned precisely with the AWT.
c. Subjects with Shorter AWT than EWT (T_0-T_a> 0): The third group included subjects whose AWT was shorter than initially EWT.

As depicted in Table 2, a notable disparity in satisfaction levels emerged between the control and the experimental groups when T_0-T_a< 0 (Z = − 2.035, p= 0.042). Conversely, when T_0-T_a= 0, no significant difference in satisfaction levels was observed between the two groups (Z = − 1.200, p= 0.230). Similarly, when T_0-T_a> 0, no significant difference in satisfaction levels was detected between the two groups (Z = − 1.416, p = 0.157).

When T_0-T_a< 0, no significant disparities emerged between the experimental and control groups concerning both the T_a (Z = − 0.478, p = 0.632) and T_0 (Z = − 0.003, p= 0.998). However, within the experimental group, a noteworthy distinction was identified between T_0 and T_1 (Z = 6.226, p = 0.000).

Specifically, as shown in Table 3, when T_0-T_a< 0, there was a significant difference in distribution between the control and experimental groups (χ^2= 13.258, p =0.001). When the satisfaction score was between 0 and 60 points, the number of subjects were 126 (31.6%) and 80 (20.3%) in control and experimental group respectively. There was significant differences in the proportion of subjects in this area between the control and experimental groups (χ^2= 13.252, p =0.001). No significant difference was observed in the number of subject between the control and the experimental groups in the other two regions, with satisfaction scores of 61 or above (χ^2= 2.301, p= 0.129; χ^2= 3.195, p= 0.074); however, in these two high satisfaction regions, the proportion of patients in the experimental group was higher than that in the control group.

Over the 61–80 points range, the experimental group exhibited a 5.1 percentage point advantage over the control group. Furthermore, in the satisfaction score bracket of 81–100 points, the experimental group comprised 42.0% of the responses, surpassing the control group by 35.8%.

Table 2 Satisfaction scores in the control and experimental groups

Conditions	Control group		Experiment group	
	Case	Scores	Case	Scores
T_0-T_a< 0	399	80.0 [60.0, 90.0][a]	395	80.0 [65.0, 90.0][a]
T_0-T_a= 0	12	100.0 [100.0, 100.0]	12	100.0 [92.5.0, 100.0]
T_0-T_a> 0	602	100.0 [100.0, 100.0]	599	100.0 [100.0, 100.0]

T_0, before updated waiting time information (UI) was given; T_a, AWT

[a] Scores in the control group vs. scores in the experimental group, P < 0.05

Table 3 The distribution of satisfaction between the experimental group and the control group when T_0-T_a< 0

	0–60	61–80	81–100
Control group	126(31.6%)	130(32.6%)	143(35.8%)
Experimental group	80(20.3%)*	149(37.7%)	166(42.0%)

*<.05

Table 4 Adjustment of EWT during peak and off-peak hours

Conditions	Effective	Invalid
Peak hours (n = 689)	513(74.5%)	176(25.5%)
off-peak hours (n = 317)	224(70.7%)	93(29.3%)

Table 5 Distribution of satisfaction score during peak and off-peak hours in experimental group

		0–60 points	61–80 points	81–100 points
Peak hours	Effective (n = 513)	43(8.4%)	89(17.3%)	381(74.3%)
	Invalid (n = 176)	33(18.8%)	46(26.1%)	97(55.1%)
Off-peak hours	Effective (n = 224)	4(1.8%)	17(7.6%)	203(90.6%)
	Invalid (n = 93)	2(2.2%)	5(5.4%)	86(92.5%)

Impact of EWT adjustment on satisfaction of patient during peak and off-peak hours

As shown in Table 4, during peak hours, among the 689 subjects, 513 subjects effectively adjusted their EWT after receiving information regarding potential waiting times, constituting 74.5% of the total. During off-peak hours, among the 317 subjects, with 224 subjects successfully adjusted their EWT after receiving relevant information, representing a percentage of 70.7%. Within the experimental group, subjects who successfully adjusted their EWT exhibited significantly higher satisfaction levels compared to those who did not achieve effective adjustment (p < 0.001, Z = 2.024).

As shown in Table 5, during peak hours, there was a significant difference in satisfaction between subjects who were effectively regulated by the EWT and those who were not (χ^2= 24.865, p= 0.000). During off-peak hours, there was no significant difference in satisfaction between subjects who were effectively regulated by the EWT and those who were not effectively regulated (χ^2 = 0.535, p = 0.765).

In particular, during peak hours, the satisfaction of the subjects who successfully adjusted their EWT was evident in two key aspects. First, there was a significant reduction in low satisfaction levels, with a decrease of 10.4% points compared to the ineffective adjustment group. Second, the high satisfaction group witnessed a notable increase of 19.2% points. A significant difference was observed in satisfaction levels between the participants during peak and off-peak hours. (p = 0.000, Z = 3.481).

Discussion

Long waiting times in outpatient settings often lead to patient dissatisfaction and can even trigger conflicts between patients and doctors [34]. Because of the critical role that AWT plays in affecting patient satisfaction that researchers and healthcare managers strive to improve overall satisfaction by reducing AWT [35, 36].

In this study, we experimentally explored the impact of adjusting the EWT of the patient through updated waiting time information intervention on their satisfaction under different relationships between AWT and EWT. The results showed that when participants' AWT exceeded their EWT, compared with the control group, adjusting the EWT of the patient through updated waiting time information, the intervention significantly increased patient satisfaction. This indicates that patient satisfaction is comprehensively influenced by both actual circumstances and expectations, with resident satisfaction in the public service sector proven to be related to the discrepancy between expected and actual service qualities [37]. Similarly, in consumer service, both AWT and EWT are key determinants of customer satisfaction [38]. As consumers form expectations concerning waiting times during the queuing process, the perceived quality of service is affected by the AWT and the degree of discrepancy between the AWT and EWT [39]. Research in these fields has revealed that individual satisfaction assessments depend on the difference between EWT and AWT, which is fundamentally consistent with the conclusions of this study.

Human behavior is influenced by internal reference points [40], which are easily modified by information and environmental factors [41]. Therefore, the evaluations and decision-making tendencies of the individuals were adjusted accordingly. Before seeking medical treatment, the EWT of the patient, based on personal experiences or situational factors, became the foundational reference point. In the control group, when the AWT exceeded the EWT, patients may have felt disappointed because they failed to meet their set "anchor" points. Conversely, in the experimental group, informing patients about potentially longer waiting times upon entering the waiting area affected their initial EWT, leading to the formation of a new EWT. This new waiting time serves as their updated "anchor," thereby changing their satisfaction assessment with the extended EWT. In the experimental group, we observed that by informing patients about longer waiting times in advance, those who effectively adjusted their EWT had significantly higher satisfaction than those who did not.

Patients often feel anxious and impatient during peak periods because of uncertainty about potentially long waits. However, once specific waiting time information is provided, certainty increases despite time loss, thereby, significantly improving patient satisfaction. In contrast, during off-peak periods, there was no significant difference in satisfaction between participants who effectively adjusted their EWT and those who did not under the influence of the updated waiting time information. This is because, during non-peak times, fewer patients are seen, waiting times are shorter, and satisfaction is generally higher. This emphasizes that informing patients about potential waiting times in advance and adjusting their EWT during peak outpatient periods helps enhance overall satisfaction levels.

This study represents an important advancement in practice by using updated waiting time information prompts regarding prolonged waiting times to adjust EWT, thereby improving patient satisfaction. Therefore, we recommend that hospitals install real-time electronic displays in waiting areas that show the current number of people waiting and possible waiting times. These displays should be updated in real time based on the queuing situation. In addition, providing mobile applications to patients to check their waiting times would allow them to query their status anytime. Clear information surrounding waiting times can help patients make informed judgments about how long they will wait, thus reducing their anxiety and dissatisfaction.

Limitations

The data used in this study originated from a pediatric hospital. As such, the generalizability of these research findings to other healthcare institutions remains uncertain. Typically, when hospitals embark on initiatives to enhance patient satisfaction by adjusting EWT, it becomes imperative to strategically implement such adjustments during peak visitation periods to achieve more substantial and impactful results. The unique characteristics and operational dynamics of individual hospitals may influence the applicability and effectiveness of similar interventions, necessitating a nuanced approach that is tailored to the specific context of each healthcare facility. In our study, due to parents needing to focus on caring for their children or being pressed for time, approximately 10% of participants indeed refused to fill out the questionnaire. We were also unable to obtain any information from these individuals, which may introduce self-selection bias. In future research, we will implement incentive measures and design as concise a questionnaire as possible to mitigate this risk. Meanwhile, in terms of wait management, a fundamental approach to genuinely improving the patient experience should focus on reducing actual waiting times. Therefore, future research should aim to reduce the actual waiting times in outpatient clinics.

Conclusion

Patient satisfaction with outpatient services is a key indicator of assessing medical service capabilities [42]. Overall, this study offered new perspectives for enhancing patient satisfaction. This highlights the importance of focusing on the impact of AWT and recognizing the significant effect of EWT on patient satisfaction. By considering both factors, medical service providers can develop more comprehensive strategies to improve the overall experience of patients seeking outpatient services.

When EWT is greater than AWT, providing updated waiting time information can significantly enhance patient satisfaction. Conversely, when the EWT was equal to or exceeded the AWT, the impact of the updated waiting time information on improving patient satisfaction was less pronounced.

During peak periods, there was a significant difference in satisfaction between patients who successfully adjusted for EWT and those who did not. Specifically, patients who effectively improved their EWT exhibited higher levels of satisfaction than those who failed make effective adjustments. In contrast, during non-peak periods, there was no significant difference in satisfaction between patients who have had EWT effectively adjusted their EWT and those who did not.

Abbreviations

AWT Actual waiting time
PWT Perceived waiting time
EWT Expected waiting time

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12913-025-12714-9.

Supplementary Material 1.

Acknowledgements

We thank the chief editor and anonymous reviewers for their valuable comments.

Authors' contributions

All authors contributed to the design of this study. The data was prepared by GX and SY. Statistical analysis was performed by ZH, TJH and QYP. The first draft of the manuscript was prepared by ZH. XW, TJH, GX and ZH reviewed and edited the manuscript. All authors read and approved the final version of the manuscript submitted for publication.

Funding

No funding.

Data availability

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

The experimental has been approved by the Research Ethics Committee of Children's Hospital of Fudan University [No. (2023) 152]. Informed consent was obtained from all study participants before the implementation of the questionnaire. All participants under the age of 16 obtained the informed consent from the parents or legal guardians.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Received: 17 August 2024 / Accepted: 7 April 2025
Published online: 14 May 2025

References

1. Okoloagu NN, Ndibuagu EO. Patients' perception and satisfaction with waiting time, and facilities available in a state teaching hospital eye clinic. Southeast Nigeria Health. 2023;15(06):544–68.
2. Pillay DI, Ghazali RJ, Manaf NH, Abdullah AH, Bakar AA, Salikin F, et al. Hospital waiting time: the forgotten premise of healthcare service delivery? Int J Health Care Qual Assur. 2011;24(7):506–22.
3. Bielen F, Demoulin N. Waiting time influence on the satisfaction-loyalty relationship in services. Managing Service Quality: Int J. 2007;17(2):174–93.
4. Ayodeji Y, Rjoub H, Özgit H. Achieving sustainable customer loyalty in airports: the role of waiting time satisfaction and self-service technologies. Technol Soc. 2023;72:1–11.
5. Sun J, Lin Q, Zhao P, et al. Reducing waiting time and Raising outpatient satisfaction in a Chinese public tertiary general hospital-an interrupted time series study. BMC Public Health. 2017;17(1):668.
6. Conner-Spady BL, Sanmartin C, Johnston GH, et al. The importance of patient expectations as a determinant of satisfaction with waiting times for hip and knee replacement surgery. Health Policy. 2011;101(3):245–52.
7. Li X, Tian D, Li W et al. Using artificial intelligence to reduce queuing time and improve satisfaction in pediatric outpatient service: A randomized clinical trial. Front Pead. 2022;1–10. https://doi.org/10.3389/ped.2022.929834
8. Stachurski M, Eriksson PO, Westman E, Mogensen H, Bonnard A. The impact of waiting time on hearing outcome and patients' satisfaction after cholesteatoma surgery. Acta Otolaryngol. 2023;143(8):662–68.
9. Ehrler F, Rochat J, Siebert JN, Guessous I, Lovis C, Spechbach H. Use of a semiautomatic text message system to improve satisfaction with wait time in the adult emergency department: Cross-sectional survey study. JMIR Med Inf. 2022;10(9):e34488.
10. Ferreira DC, Marques RC, Nunes AM, et al. Patients' satisfaction: the medical appointments Valence in Portuguese. Public Hosp Omega. 2018;80(10):58–76.
11. Freckmann M, Seipp A, Laass MW, Koletzko S, Classen M, Ballauff A, et al. School-related experience and performance with inflammatory bowel disease: results from a cross-sectional survey in 675 children and their parents. BMJ Open Gastroenterol. 2018;5(1):e000236.
12. Bahammam FA. Satisfaction of clinical waiting time in ear, nose & throat departments of the ministry of health in Jeddah, Saudi Arabia. Health Serv Insights. 2023;16:1–6. https://doi.org/10.1177/11786329231183315
13. Sharma N, Aggarwal AK, Arora P, Bahuguna P. Association of waiting time and satisfaction level of patients with online registration system in a tertiary level medical Institute outpatient department (OPD). Health Policy Technol. 2022;11(4):100687.

14. Munavalli JR, Rao SV, Srinivasan A, et al. Integral patient scheduling in outpatient clinics under demand uncertainty to minimize patient waiting times. Health Inf J. 2020;26(1):435–48.
15. Liu N, van Jaarsveld W, Wang S, et al. Managing outpatient service with strategic walk-ins. Manage Sci. 2023;69(10):5904–22.
16. Tunçalp F, Güneş ED, Örmeci EL. Modeling strategic walk-in patients in appointment systems: equilibrium behavior and capacity allocation. Eur J Oper Res. 2024;313(2):587–601.
17. Golmohammadi D, Zhao L, Dreyfus D. Using machine learning techniques to reduce uncertainty for outpatient appointment scheduling practices in outpatient clinics. Omega. 2023;120:1–17.
18. Fu S, Wu X-G, Zhang L, et al. Service quality improvement of outpatient blood collection by lean management. Patient Prefer Adherence. 2021;15:1537–43.
19. Harada Y, Shimizu T. Impact of a commercial artificial Intelligence-Driven patient Self-Assessment solution on waiting times at general internal medicine outpatient departments: retrospective study. JMIR Med Inf. 2020;8(8):e21056.
20. Santos-Jaen JM, Valls Martinez MDC, Palacios-Manzano M, et al. Analysis of patient satisfaction through the effect of healthcare spending on waiting times for consultations and operations. Healthc (Basel). 2022;10(7):1229.
21. Pruyn A, Smidts A. Effects of waiting on the satisfaction with the service: beyond objective time measures. Int J Res Market. 1998;15(4):321–24.
22. Aeschbach V, Ehret S, Post J, et al. The effect of waiting environment and perceived atmosphere on Temporal experience. Adv Cogn Psychol. 2022;18(2):132–43.
23. Lee J, Yoon S-Y. Nature and patient waiting: mediating effects of anxiety and perceived wait time on the association between nature and service perception. J Environ Psychol. 2023;91:1–13.
24. Kumar P, Dada M. Investigating the impact of service line formats on satisfaction with waiting. Int J Res Mark. 2021;38(4):974–93.
25. Zhang H, Ma W, Zhou S et al. Effect of waiting time on patient satisfaction in outpatient: An empirical investigation. Medicine. 2023;102(40):1–5.
26. Campos Sousa E, Freire L. The effect of brief mindfulness-based intervention on patient satisfaction and loyalty after waiting. J Consum Aff. 2022;57(2):906–42.
27. Nair RD, Mohammadnezhad M. It's a waste of time coming here, better go to private clinics with wider options for treatment: patient's perception on dental services provided in Fiji. BMC Health Serv Res. 2022;22(1):1–10.
28. Caruelle D, Lervik-Olsen L, Gustafsson A. The clock is ticking—Or is it? Customer satisfaction response to waiting shorter vs. longer than expected during a service encounter. J Retail. 2023;99(2):247–64.
29. Naumann S, Miles JA. Managing waiting patients' perceptions. The role of process control. J Manag Med. 2001;15(5):376–86.
30. Ma W-M, Zhang H, Wang N-L. Improving outpatient satisfaction by extending expected waiting time. BMC Health Serv Res. 2019;19(1):565.
31. Kapoor DA. Determinants of patient satisfaction with urology practice. Urol Pract. 2014;1(3):122–26.
32. Chu H, Westbrook RA, Njue-Marendes S, et al. The psychology of the wait time experience - what clinics can do to manage the waiting experience for patients: a longitudinal, qualitative study. BMC Health Serv Res. 2019;19(1):459.
33. Zhang H, Ma W-M, Zhu J-J et al. How to adjust the expected waiting time to improve patient's satisfaction? BMC Health Serv Res. 2023;23(1):1–8.
34. Zhang H, Wang WH, Haggerty J, et al. Predictors of patient satisfaction and outpatient health services in china: evidence from the WHO SAGE survey. Fam Pract. 2020;37(4):465–72.
35. Ataman MG, Sarıyer G. Predicting waiting and treatment times in emergency departments using ordinal logistic regression models. Am J Emerg Med. 2021;46:45–50.
36. Chen J, Alturas B. Improvement of outpatient service processes: a case study of the university of Hong Kong-Shenzhen hospital. Health Technol. 2023;13(6):971–85.
37. Bellé N, Belardinelli P, Cucciniello M et al. Experimental evidence on the determinants of citizens' expectations toward public services. Public Adm Rev. 2023. https://doi.org/10.1111/puar.13775
38. Davis MM, Heineke J. How disconfirmation, perception and actual waiting times impact customer satisfaction. Int J Serv Ind Manag. 1998;9(1):64–73.
39. Jiang T, Gao L, Chai X. Equilibrium queueing strategies in M/G/1 queues with the reference time effect. Methodol Comput Appl Probab. 2023;25(4):1–27. https://doi.org/10.1007/s11009-023-10062-x
40. Li ZH, Zhong SF. Reference dependence in intertemporary preferences. Manage Sci. 2023;69(1):475–90.
41. Willis R, Evandrou M, Pathak P, et al. Problems with measuring satisfaction with social care. Health Soc Care Commun. 2016;24(5):587–95.
42. Shen J, Zhang J, He Q, et al. Without the need for a second visit initiative improves patient satisfaction with updated services of outpatient clinics in China. BMC Health Serv Res. 2021;21(1):267.

Publisher's Note