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Appointments Do Not Guarantee Higher Patient Satisfaction:

Departmental Heterogeneity in Outpatient Waiting Performance

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Abstract

Background: Appointment systems are intended to improve patient flow and service quality, but an appointment may not entail a shorter actual wait or greater satisfaction in every department, even within the same hospital. We compared actual waiting time and satisfaction with waiting between patients with appointments and walk-in patients across two outpatient departments, and explored how appointment-window alignment and expectation fulfillment related to satisfaction.

Methods: We conducted a cross sectional survey of single waiting episodes among patients attending the ophthalmology and gynecology outpatient departments in a tertiary hospital in china. 996 questionnaires were analyzed. Adjusted models containing an appointment status by department interaction assessed departmental heterogeneity, controlling for age, sex, educational, and previous visits. Appointment only exploratory analyses compared expected call times with scheduled windows and evaluated whether actual waiting exceeded expected waiting.

Results: After adjustment, patients with appointments waited 6.43 minutes less than walk-in patients in ophthalmology (95% CI: -9.02 to -3.84; Holm-adjusted $P < 0.001$), whereas the corresponding difference in gynecology was -1.53 minutes (95% CI: -3.77 to 0.72; Holm-adjusted $P = 0.184$). The between-department difference was 4.91 minutes (95% CI: 1.51 to 8.30; Holm-adjusted $P = 0.009$). In satisfaction model 1, the appointment-related contrast was 8.15 points in ophthalmology (95% CI: 5.88 to 10.43; Holm-adjusted $P < 0.001$) and -0.41 points in gynecology (95% CI: -2.19 to 1.38; Holm-adjusted $P = 0.656$); the between-department contrast was -8.56 points (95% CI: -11.46 to -5.66; Holm-adjusted $P < 0.001$). Among 527 appointment patients, 223 (42.3%) waited longer than expected; this was associated with 8.78 points lower adjusted satisfaction (95% CI: -10.63 to -6.93; $P < 0.001$). The satisfaction pattern across four appointment expectation subgroups differed by department (Wald $\chi^2 = 28.77$, $df = 4$; $P < 0.001$).

Conclusions: Appointment status was not consistently associated with greater satisfaction with waiting. Department specific waiting performance and whether actual waiting exceeded patients' expectations were more informative than appointment status

or scheduled-window alignment alone. These findings describe observational associations and do not establish causal effects.

Keywords: appointments; outpatients; satisfaction with waiting; actual waiting time; expected waiting time; appointment punctuality; departmental heterogeneity

Background

Patient satisfaction is a key indicator of health service quality[1]. Compared with the technical quality of care, waiting time is one aspect of service performance that patients can directly perceive during a visit, even it' s one of the earliest experiences that patients' formed through their interaction with a hospital. Previous studies have consistently found that longer actual waiting times are associated with lower patient satisfaction [2,3]. This association may extend beyond satisfaction with waiting to perceptions of service convenience, healthcare professionals, and overall quality of care [4-6]. Subjective time measures, including expected and perceived waiting, and the discrepancy between expected and actual waiting may also shape satisfaction [7]. Improving patient flow and reducing avoidable waiting under concentrated demand and limited resources have therefore become important concerns in health-service management.

Appointment systems are widely used to coordinate patient arrivals with service capacity. Their basic purpose is to allocate visit times in advance, reduce clustered arrivals and disorderly on-site queues, and improve the use of outpatient resources [8-11]. Previous studies have associated online appointment systems and comprehensive appointment services with shorter registration and waiting times and greater patient satisfaction [12-14]. A systematic review of outpatient appointment systems likewise found that most published studies reported shorter waits and improved satisfaction [15]. In routine outpatient practice, however, appointment systems must accommodate variation in service duration, early or late arrivals, no shows, unscheduled arrivals, and different priority rules [8-11].

Simulation studies comparing shared and separate queues for appointment and walk-in patients have shown that waiting outcomes depend on the operating parameters; the mix of patients, service times, and no show rates can change the relative waits of the two groups [16]. Research on real time scheduling and dual channel services further indicates that capacity allocation between appointments and walk-ins, patient choice, and the balance between demand and capacity jointly influence system performance, with no single arrangement optimal for every outpatient setting [17-20]. The

operational value of an appointment system therefore depends on how its scheduling rules are embedded in the local service process, rather than simply on whether such a system exists.

Improvement in hospital-level indicators after the introduction of an appointment system does not mean that every patient with an appointment will wait less or be more satisfied than a walk-in patient. Appointment status identifies the registration and scheduling pathway through which a patient enters outpatient care. Actual waiting time, by contrast, captures the time from ticket collection or registration to being called for consultation. Although an appointment assigns a scheduled time window, whether it produces a perceptible waiting advantage after arrival depends on how the appointment schedule operates within the department. Prior evidence also suggests that satisfaction results associated with appointments depend on the indicator examined: a higher proportion of same-day appointments was associated with satisfaction with timely access to care, whereas the proportion of appointments available within 24 hours showed no such association, and neither measure was significantly associated with overall satisfaction [21]. Awareness and use of online appointment booking also vary not only with patient characteristics but with the way institutions organize appointment and registration processes [22]. Comparisons based only on hospital wide indicators before and after implementation, or between users and non-users of an appointment system, may therefore fail to show whether associations with waiting time and satisfaction are consistent across departments.

Department level comparisons are particularly important for understanding the practical value of appointments. Queueing models and prospective operational evaluations show that outpatient waiting and scheduling performance are shaped by individual clinicians, service processes, patient demand, and capacity allocation, and that improvement strategies should be designed for specific clinical settings [23, 24]. Thus, even when departments use the same appointment platform, the actual waiting-time difference between appointment and walk-in patients may vary. Pooling departments may conceal heterogeneity if appointment patients wait less than walk-ins in one department but not in another. Appointment punctuality and the waiting

advantage of appointment patients over walk-ins are also distinct operational measures. Punctuality indicates whether appointment patients receive care within or before their scheduled window, whereas relative waiting advantage requires direct comparison of actual waits from registration or ticket collection to call time. A department can have high appointment punctuality without appointment patients waiting less than walk-in patients in that department. Punctuality, actual waiting differences, and patient satisfaction should therefore be examined together rather than treated as interchangeable measures.

Patients' evaluations of waiting may also depend on how long they expected to wait. Satisfaction has been associated with actual waiting time [6], expected waiting time, and discrepancies between expected and actual waiting [7, 25]. Patients with the same actual wait may therefore evaluate the experience differently if their expectations differ. Comparing satisfaction by appointment status without accounting for actual and expected waiting may combine the effects of the registration pathway, objective waiting performance, and patient expectations. Patient characteristics, including age, sex, educational attainment, and previous visits, may also be related to appointment use or satisfaction and should be controlled for [2, 3, 22]. Previous experience at the hospital may further be associated with familiarity with appointment procedures and is therefore relevant to an exploratory comparison of appointment use.

Using cross sectional survey data from two outpatient departments, this study examined the relationships among appointment status, actual waiting time, expected waiting time, appointment punctuality, and satisfaction with waiting. The primary research question was whether appointment-related differences in actual waiting time and satisfaction varied by department. Secondary questions were whether appointment punctuality differed between departments; whether appointment status remained associated with satisfaction after accounting for actual waiting time, expected waiting time, and patient characteristics; whether expected waiting time differed between appointment and walk-in patients; and whether appointment use differed between patients with and without previous visits to the hospital. We did not seek to establish that appointment status caused changes in waiting time or satisfaction. Instead, we

distinguished appointment pathway, appointment punctuality, and actual waiting performance to identify department-specific associations between appointments and patient experience.

Methods

Study design and setting

This cross sectional observational study used a single outpatient waiting episode as the unit of analysis and included patients in the ophthalmology and gynecology departments of the same hospital. Ophthalmology is a high volume specialty department at the hospital, where patients generally experience longer waits, whereas gynecology has a lower outpatient volume and shorter waits. The departments were selected because their outpatient processes and waiting performance differed, allowing assessment of whether appointment-related differences in waiting and satisfaction varied by department. The study was conducted at The Second Affiliated Hospital of Zhejiang Chinese Medical University, and data were collected from November 2025 to June 2026.

Participants

Participants were patients waiting for consultation in the ophthalmology or gynecology outpatient waiting areas of a tertiary hospital in Zhejiang Province, China. Researchers approached eligible patients in the waiting area, explained the purpose and procedures of the study, and obtained informed consent before questionnaire completion. Patients completed the questionnaires themselves; accompanying family members did not complete them on the patients' behalf.

Data were collected in two stages to obtain patients expectations before consultation and their subsequent waiting experience. In stage 1, immediately after entering the waiting area, patients completed the first part of the questionnaire. At that time, they reported how many minutes, before coming to the hospital, they had expected to wait from registration until the doctor began the consultation. Researchers recorded the registration number and date on the back of the questionnaire and subsequently documented check-in time. In stage 2, immediately before patients entered the consultation room after being called, they completed the second part of the

questionnaire, and researchers again recorded the registration number and date on the reverse. These identifiers were used to link the two parts into one complete waiting-episode record (See as supplementary file 1).

A total of 1,502 patients were invited, of whom 1,277 agreed to participate and 225 declined. Complete paired questionnaires were obtained from 1,001 patients. Under the data-cleaning rules, five duplicate records were excluded, leaving 996 questionnaires for analysis.

Measures

Appointment status and previous visits: Patients were classified as having registered with an appointment or as walk-in patients. Previous visit experience was classified as yes or no according to whether the patient reported having previously attended the hospital.

Actual waiting time: Actual waiting time was calculated according to appointment status. For appointment patients, it was defined as the interval, in minutes, from check-in time to call time. For walk-in patients, it was defined as the interval from registration time to call time. Call time was recorded immediately before the patient entered the consultation room. This measure captured only the pre-consultation waiting period.

Expected waiting time: Before being called, patients self-reported the number of minutes they expected to wait for the current consultation in the stage 1 questionnaire.

Appointment punctuality: Punctuality was evaluated only among patients with appointments and was determined from the pre-specified appointment window. The primary definition classified a patient as punctual if called no later than the end of the appointment window. The strict definition required the patient to be called within the appointment window.

Satisfaction with waiting: Immediately before entering the consultation room, patients rated their satisfaction with the waiting experience on a scale from 0 to 100, with higher scores indicating greater satisfaction.

Patient characteristics: The questionnaire collected age group, sex, educational attainment, and previous visit experience. These variables were included because they

may be associated with waiting expectations, use of appointment services, or satisfaction.

Statistical analysis

Data was analysed by IBM SPSS Statistics version 27.0 and Python 3.x. Categorical variables are presented as numbers and percentages. Continuous variables are presented as medians and interquartile ranges, or as means and standard deviations where specified. Unadjusted comparisons of actual waiting time, expected waiting time, and satisfaction between two independent groups were performed using the Mann–Whitney U test, with standardized Z statistics reported. The association between previous visit experience and appointment use was examined using Pearson’s chi-square test. These unadjusted comparisons were considered exploratory. To test whether the association between appointment status and actual waiting time varied by department, we fitted an ordinary least-squares linear model with actual waiting time in minutes as the outcome and heteroskedasticity-consistent (HC3) covariance estimates. The model included appointment status, department, and their interaction and adjusted for age group, sex, educational attainment, and previous visit experience. From the interaction model, we estimated the adjusted mean difference in waiting time between appointment and walk-in patients within each department. The appointment status by department interaction tested whether the appointment-related waiting-time contrast differed between departments.

Satisfaction scores were divided by 100 and analyzed using fractional logit models with HC3 sandwich covariance estimates. Standardized marginal predictions and contrasts were converted back to the 0–100-point scale. Model 1 included appointment status, department, their interaction, and the pre-specified covariates. Model 2 added actual waiting time. Model 3 further added expected waiting time and the pre-specified appointment status-by-expected waiting time and department-by-expected waiting time interactions. All models retained the appointment status by department interaction. Average changes associated with a 10-minute increase in the main sequential models were estimated by increasing the relevant wait by 10 minutes for each observed covariate pattern. The sequential models were not interpreted as mediation or

causal-effect estimates.

The confirmatory contrasts comprised the appointment-versus-walk-in difference within ophthalmology, the corresponding difference within gynecology, and the appointment status-by-department interaction. Within each primary outcome, raw P values were adjusted using Holm's step down procedure. For the primary and strict punctuality definitions, department differences used an unpooled two-sample Wald test with Newcombe-Wilson confidence intervals; the two P values were Holm-adjusted. Sensitivity analyses were restricted to female patients and, separately, excluded patients whose actual wait exceeded 75 minutes. Model rank, collinearity, residuals, heteroskedasticity, leverage, influence, convergence, and prediction ranges were checked as appropriate. All tests were two-sided, and 95% confidence intervals were reported.

Exploratory expectation analyses

Among appointment patients, expected call time was classified as before, within, or after the inclusive scheduled window recorded in the workbook. To assess partial anchoring, expected waiting time was regressed on the number of minutes from registration to the appointment-window midpoint using OLS-HC3, adjusting for appointment-window clock time, department, age group, sex, education, and previous visit experience. We also fitted a department interaction and repeated the pooled model after excluding the single observation in the sparsest time window.

Expectation fulfillment was defined as actual waiting time less than or equal to expected waiting time; actual waiting greater than expected was classified as exceeding expectation. Appointment-only fractional logit models examined expected waiting alone, actual and expected waiting together, exceeding expectation, and expected-call position while adjusting for scheduled-window midpoint, department, and the pre-specified covariates. Average marginal effects for continuous waits were reported per 10 minutes.

For comparison with walk-in patients, appointment patients were grouped as expected call within versus outside the scheduled window and expectation met versus exceeded. Fractional logit models compared each of the four groups with walk-in patients and formally tested group-by-department interactions, adjusting for the pre-specified covariates. Within pooled and department-specific comparison families, four P values were Holm-adjusted. Because only three patients had an expected call after the window and an actual wait that exceeded expectation, before and after window categories were combined as outside the window. These analyses were exploratory.

Ethics and consent

This was a minimal risk, non-interventional questionnaire study involving no drugs, medical devices, blood collection, biological samples, additional examinations, or other clinical procedures. Participation did not change waiting order, routine care, or clinical decisions. Questionnaires were completed anonymously, and the study did not retain directly identifying information.

Before data collection, the protocol was submitted to the Ethics Committee of The Second Affiliated Hospital of Zhejiang Chinese Medical University. The committee determined that this minimal-risk, non-interventional questionnaire study was exempt from ethical review. All procedures were conducted in accordance with the Declaration of Helsinki and relevant institutional requirements. Before participation, researchers explained the purpose of the study, the voluntary nature of participation, that refusal or withdrawal would not affect routine care, and measures used to protect privacy. Informed consent was obtained from all participants.

3. Results

3.1 Basic information

Among the 996 valid questionnaires, 500 were from ophthalmology and 496 from gynecology (Table 1). Overall, 527 patients (52.9%) had appointments: 222 of 500 (44.4%) in ophthalmology and 305 of 496 (61.5%) in gynecology. A total of 773 patients (77.6%) reported a previous visit to the hospital. Of these, 419 (54.2%) had appointments, compared with 108 of 223 first-time patients (48.4%).

Table 1 Participants characteristics by department and appointment status

Characteristic	Ophthalmology	Ophthalmology	Gynecology	Gynecology	Total
	Appointment	Walk-in	Appointment	Walk-in	
Age					
<18 years	10 (4.5%)	11 (4.0%)	9 (3.0%)	8 (4.2%)	38 (3.8%)
18-36 years	70 (31.5%)	114 (41.0%)	168 (55.1%)	113 (59.2%)	465 (46.7%)
>36 years	142 (64.0%)	153 (55.0%)	128 (42.0%)	70 (36.6%)	493 (49.5%)
Sex					
Female	157 (70.7%)	178 (64.0%)	305 (100.0%)	191 (100.0%)	831 (83.4%)
Male	65 (29.3%)	100 (36.0%)	0 (0.0%)	0 (0.0%)	165 (16.6%)
Education					
High school or below	102 (45.9%)	136 (48.9%)	55 (18.0%)	53 (27.7%)	346 (34.7%)
College or bachelor's degree	109 (49.1%)	132 (47.5%)	188 (61.6%)	123 (64.4%)	552 (55.4%)
Postgraduate	11 (5.0%)	10 (3.6%)	62 (20.3%)	15 (7.9%)	98 (9.8%)
Previous visit					
: yes	170 (76.6%)	210 (75.5%)	249 (81.6%)	144 (75.4%)	773 (77.6%)
no	52 (23.4%)	68 (24.5%)	56 (18.4%)	47 (24.6%)	223 (22.4%)
Total	222	278	305	191	996

3.2 Expected waits differed within, but not overall, by appointment status

Overall, expected waiting time did not differ between appointment and walk-in patients (15.0 [10.0, 30.0] versus 15.0 [10.0, 30.0] minutes; $Z = -0.418$, $P = 0.676$). Within

ophthalmology, the distribution of expected waiting time differed between appointment and walk-in patients ($Z = -4.164$, $P < 0.001$). A difference was also observed in gynecology ($Z = -3.095$, $P = 0.002$) (Table 2).

Table 2 Waiting measures, appointment punctuality, and satisfaction by study group

Measure	Ophthalmology	Ophthalmology	Gynecology	Gynecology	Total
	Appointment	Walk-in	Appointment	Walk-in	
Actual waiting time, min	25.0 [15.0, 32.0]	30.0 [25.0, 35.0]	15.0 [10.0, 25.0]	15.0 [10.0, 30.0]	20.0 [15.0, 30.0]
Expected waiting time, min	20.0 [14.8, 30.0]	15.0 [10.0, 30.0]	15.0 [10.0, 20.0]	15.0 [10.0, 25.0]	15.0 [10.0, 30.0]
Called no later than					
appointment-window end, n	200 (90.1%)	/	290 (95.1%)	/	490 (93.0%)
(%)					
Called within appointment					
window, n (%)	182 (82.0%)	/	255 (83.6%)	/	437 (82.9%)
Satisfaction with waiting,	90.0 [85.0,	85.0 [70.0, 95.0]	95.0 [90.0, 100.0]	95.0 [90.0, 100.0]	90.0 [85.0, 100.0]
points	100.0]				

3.3 Appointments were associated with shorter waits only in ophthalmology

Overall, actual waiting time differed between appointment and walk-in patients (20.0 [10.0, 30.0] versus 30.0 [15.0, 35.0] minutes; $Z = -6.782$, $P < 0.001$). The difference was observed in ophthalmology ($Z = -5.632$, $P < 0.001$) but not in gynecology ($Z = -1.606$, $P = 0.108$). The waiting advantage associated with appointments was concentrated in the department with longer actual waits.

After adjustment for age group, sex, educational attainment, and previous visit experience, appointment patients in ophthalmology waited 6.43 minutes less than walk-in patients (95% CI: -9.02 to -3.84 ; Holm-adjusted $P < 0.001$). The adjusted difference in gynecology was -1.53 minutes (95% CI: -3.77 to 0.72 ; Holm-adjusted $P = 0.184$). The appointment-related waiting-time contrast differed by 4.91 minutes between departments (gynecology minus ophthalmology; 95% CI: 1.51 to 8.30 ;

Holm-adjusted $P = 0.009$), supporting departmental heterogeneity (Table 3).

Table 3 Adjusted associations between appointment status and actual waiting time by department

Outcome	Contrast	Estimate	95% CI	Holm-adjusted P value
Actual waiting time, min	Ophthalmology: appointment vs walk-in	-6.43	-9.02 to -3.84	<0.001
Actual waiting time, min	Gynecology: appointment vs walk-in	-1.53	-3.77 to +0.72	0.184
Actual waiting time, min	Interaction: gynecology minus ophthalmology	+4.91	+1.51 to +8.30	0.009

3.4 Appointment punctuality was high in both departments

Among appointment patients, 200 of 222 (90.1%) in ophthalmology and 290 of 305 (95.1%) in gynecology were called no later than the end of their appointment window (Tables 2 and 4). The rate was 4.99 percentage points higher in gynecology (95% CI: 0.53 to 10.01; raw $P = 0.034$), but the difference was not statistically significant after Holm adjustment ($P = 0.068$). Under the strict definition, 82.0% of ophthalmology patients and 83.6% of gynecology patients were called within the appointment window, a difference of 1.62 percentage points (95% CI: -4.79 to 8.34; Holm-adjusted $P = 0.627$).

Table 4 Appointment punctuality by department

Definition	Ophthalmology	Gynecology	Difference, percentage points	95% CI	Raw P; Holm-adjusted P
Called no later than appointment-window end	200/222 (90.1%)	290/305 (95.1%)	4.99	+0.53 to +10.01	0.034; 0.068
Called within appointment window	182/222 (82.0%)	255/305 (83.6%)	1.62	-4.79 to +8.34	0.627; 0.627

3.5 Higher satisfaction among appointment patients was confined to ophthalmology

The median satisfaction score was 90.0 [85.0, 100.0]. Satisfaction was 5.0 points higher in gynecology than in ophthalmology (95.0 [90.0, 100.0] versus 90.0 [80.0, 99.0]; $Z = -8.537$, $P < 0.001$). In ophthalmology, appointment patients reported higher satisfaction than walk-in patients (90.0 [85.0, 100.0] versus 85.0 [70.0, 95.0]; $Z = 5.904$, $P < 0.001$). In gynecology, the groups did not differ (95.0 [90.0, 100.0] in both groups; $Z = -0.721$, $P = 0.471$).

Model 1 included appointment status, department, their interaction, age group, sex, educational attainment, and previous visit experience. Model 2 added actual waiting time. Model 3 added expected waiting time and the pre-specified appointment status-by-expected waiting time and department-by-expected waiting time interactions. The appointment status by department interaction remained in all three models. Changes in the appointment contrast across models describe the strength of the conditional association after additional waiting variables were included.

In model 1, adjusted predicted satisfaction in ophthalmology was 90.1 points for appointment patients and 81.9 points for walk-in patients, a difference of 8.15 points (95% CI: 5.88 to 10.43; Holm-adjusted $P < 0.001$). The corresponding predicted values in gynecology were 92.4 and 92.8 points, a difference of -0.41 points (95% CI: -2.19 to 1.38 ; Holm-adjusted $P = 0.656$). The appointment-related satisfaction contrast differed by -8.56 points between departments (gynecology minus ophthalmology; 95% CI: -11.46 to -5.66 ; Holm-adjusted $P < 0.001$), supporting departmental heterogeneity.

After actual waiting time was added in model 2, the appointment-related satisfaction contrast in ophthalmology decreased from 8.15 to 4.96 points; the contrast in gynecology was -0.78 points, and the between-department contrast was -5.74 points. Each 10 minute increase in actual waiting time was associated with a 3.51 point decrease in predicted satisfaction (95% CI: -4.23 to -2.78 ; $P < 0.001$).

After expected waiting time and its pre-specified interactions were added in model 3, appointment-related contrasts in ophthalmology, gynecology, and between departments were 2.50, -0.55 , and -3.05 points, respectively. Each 10-minute increase in actual

waiting time was associated with a 4.06 point decrease in satisfaction, whereas each 10 minute increase in expected waiting time was associated with a 2.46 point increase. These sequential models describe adjusted conditional associations and do not estimate mediation or causal effects (Table 5).

Table 5 Marginal satisfaction contrasts across sequential models

Marginal contrast, points	Model 1 (Holm P)	Model 2 (raw P)	Model 3 (raw P)
Ophthalmology: appointment vs walk-in	+8.15 (+5.88 to +10.43); P<0.001	+4.96 (+2.97 to +6.96); P<0.001	+2.50 (+0.55 to +4.45); P=0.012
Gynecology: appointment vs walk-in	-0.41 (-2.19 to +1.38); P=0.656	-0.78 (-2.54 to +0.99); P=0.389	-0.55 (-2.26 to +1.17); P=0.531
Interaction: gynecology minus ophthalmology	-8.56 (-11.46 to -5.66); P<0.001	-5.74 (-8.39 to -3.09); P<0.001	-3.05 (-5.62 to -0.48); P=0.020
Actual waiting time per 10-minute increase	Not applicable	-3.51 (-4.23 to -2.78); P<0.001	-4.06 (-4.84 to -3.28); P<0.001
Expected waiting time per 10-minute increase	Not applicable	Not applicable	+2.46 (+1.95 to +2.96); P<0.001

3.6 Appointment expectations, fulfillment, and satisfaction

Among 527 appointment patients, expected call time was before the scheduled window for 78 (14.8%), within it for 414 (78.6%), and after it for 35 (6.6%). The expected call time was a median of 10 minutes after the window start (IQR: 3 to 19) and 5 minutes before the midpoint (IQR: -12 to 4). After adjustment, each 10-minute increase in the time from registration to the scheduled-window midpoint was associated with a 3.00-minute increase in expected waiting time (95% CI: 1.71 to 4.29; P<0.001), consistent with partial rather than one-to-one anchoring. The department-specific slopes did not differ clearly (interaction P=0.196), and exclusion of the single observation in the sparsest time window produced a similar estimate of 2.95 minutes.

Actual waiting exceeded expected waiting for 223 appointment patients (42.3%). Mean satisfaction was 94.66 points (SD: 6.63) when expectation was met and 86.92 points (SD: 12.20) when actual waiting exceeded expectation. After adjustment for expected waiting,

scheduled-window midpoint, department, and patient characteristics, exceeding expectation was associated with 8.78 points lower satisfaction (95% CI: −10.63 to −6.93; $P<0.001$). Expected waiting alone was not clearly associated with satisfaction (average marginal effect per 10 minutes −0.20 points; 95% CI: −0.93 to 0.52; $P=0.584$). When actual and expected waits were included together, their average marginal effects per 10 minutes were −3.08 points (95% CI: −4.17 to −1.99) and +1.96 points (95% CI: 1.12 to 2.79), respectively. After accounting for both waits, expected-call position itself was not clearly associated with satisfaction (before versus within: +0.80 points, $P=0.495$; after versus within: −3.06 points, $P=0.087$).

Compared with walk-in patients, appointment patients whose expected call was within the scheduled window and whose actual wait did not exceed expectation had 7.36 points higher adjusted satisfaction in the pooled model. The corresponding pooled difference was 6.16 points for patients outside the window whose expectation was met; neither subgroup whose actual wait exceeded expectation showed a clear pooled advantage. The pattern differed by department (group-by-department Wald $\chi^2=28.77$, $df=4$; $P<0.001$). In ophthalmology, the within-window/exceeded group still had 5.09 points higher satisfaction than walk-in patients, whereas in gynecology it had 4.95 points lower satisfaction. The outside-window/exceeded group had 8.24 points lower satisfaction than walk-in patients in gynecology but no clear difference in ophthalmology (Table 6).

Table 6 Satisfaction differences from walk-in patients by expectation subgroup

Appointment expectation subgroup	N	Pooled	Ophthalmology	Gynecology
Within window; expectation met	251	+7.36 (+5.90 to +8.82); $P<0.001$	+11.00 (+8.65 to +13.36); $P<0.001$	+3.10 (+1.40 to +4.79); $P=0.001$
Within window; expectation exceeded	163	+0.25 (−1.93 to +2.43); $P=0.821$	+5.09 (+2.06 to +8.13); $P=0.002$	−4.95 (−7.83 to −2.07); $P=0.002$
Outside window; expectation met	53	+6.16 (+3.99 to +8.33); $P<0.001$	+9.70 (+6.57 to +12.83); $P<0.001$	+1.97 (−0.88 to +4.81); $P=0.175$

Appointment expectation subgroup	N	Pooled	Ophthalmology	Gynecology
Outside window; expectation exceeded	60	-2.63 (-6.54 to +1.28); P=0.376	+3.45 (-1.95 to +8.85); P=0.210	-8.24 (-13.20 to -3.27); P=0.002

3.7 Sensitivity analyses

When the analysis was restricted to 831 female patients, the between-department appointment-related contrast was 4.51 minutes for actual waiting time (95% CI: 0.64 to 8.37; Holm-adjusted $P=0.045$) and -8.02 points for satisfaction in model 1 (95% CI: -11.33 to -4.71; Holm-adjusted $P<0.001$). Both were consistent in direction with the primary analyses. After six patients with actual waiting times exceeding 75 minutes were excluded, the actual waiting-time interaction was 5.13 minutes (95% CI: 2.07 to 8.19; Holm-adjusted $P=0.002$), the model 1 satisfaction interaction was -8.53 points, and the model 2 interaction was -5.14 points. The central findings were unchanged (Table 7).

Table 7 Sensitivity analyses

Analysis	Ophthalmology	Gynecology	Interaction: gynecology minus ophthalmology
Female patients only: actual waiting time, min	-6.18 (-9.33 to -3.03); P<0.001	-1.67 (-3.92 to +0.57); P=0.144	+4.51 (+0.64 to +8.37); P=0.045
Female patients only: satisfaction model 1, points	+7.66 (+4.91 to +10.41); P<0.001	-0.36 (-2.16 to +1.44); P=0.699	-8.02 (-11.33 to -4.71); P<0.001
Waiting ≤ 75 min: actual waiting time, min	-7.05 (-9.26 to -4.83); P<0.001	-1.92 (-4.04 to +0.20); P=0.076	+5.13 (+2.07 to +8.19); P=0.002
Waiting ≤ 75 min: satisfaction model 1, points	+8.24 (+6.00 to +10.49); P<0.001	-0.28 (-2.06 to +1.49); P=0.753	-8.53 (-11.41 to -5.65); P<0.001
Waiting ≤ 75 min: satisfaction model 2, points	+4.08 (+2.17 to +6.00); P<0.001	-1.06 (-2.79 to +0.67); P=0.229	-5.14 (-7.72 to -2.57); P<0.001

4 Discussion

This study identified marked departmental heterogeneity in the associations between appointment status and patient experience. In ophthalmology, appointment patients had shorter actual waits and greater satisfaction with waiting than walk-in patients; no corresponding advantage was observed in gynecology. Exploratory analyses further showed that actual waiting exceeding expected waiting was strongly associated with lower satisfaction and that the satisfaction pattern across expectation subgroups differed by department.

This pattern is consistent with the interpretation that the value of appointments for patient experience may depend on whether a department converts scheduling into a waiting advantage that patients can perceive. However, we did not comprehensively measure operating processes within each department, and appointment status was not randomly assigned. The findings therefore do not establish that waiting performance caused the department-specific satisfaction differences.

Appointment punctuality alone did not explain the observed pattern. Under the primary definition, appointment punctuality was 5 percentage points higher in gynecology than in ophthalmology, and under the stricter definition of being called within the appointment window, the departments had similar punctuality rates. By contrast, the waiting-time advantage of appointment patients over walk-in patients was more pronounced in ophthalmology. Appointment punctuality captures whether patients receive service by a scheduled threshold, whereas an appointment-related waiting advantage captures how appointment patients' actual waits compare with those of walk-in patients in the same department. These measures are related but not interchangeable.

The expectation findings clarify why scheduled-window alignment alone is an incomplete patient-experience measure. Most appointment patients placed their expected call within the scheduled window, and expected waiting increased only about 3 minutes for each additional 10 minutes from registration to the window midpoint, suggesting partial anchoring. However, once actual and expected waiting were considered, whether the expected call fell before, within, or after the window did not

show a clear independent association with satisfaction. By contrast, actual waiting that exceeded expected waiting was associated with substantially lower satisfaction. This pattern is consistent with expectation-disconfirmation theory and prior outpatient evidence [7, 25], but the cross-sectional models cannot establish a psychological mechanism or causal mediation pathway.

Previous studies have shown that scheduling interventions such as advanced access and online appointments can shorten the time to obtain an appointment or the in-hospital wait, but their effects on satisfaction have been inconsistent [26, 27]. Evidence from a large outpatient survey also indicates that longer actual waiting time is generally associated with lower patient satisfaction, although the strength of this association may vary with waiting duration and service context [28]. Our results are broadly consistent with this evidence and further suggest that the relationships among appointment status, actual waiting time, and satisfaction need not be the same across departments. Operations-management and clinical-practice studies have emphasized that outpatient scheduling is more than the allocation of time slots: its performance is jointly shaped by process complexity, patient mix, and heterogeneity in service times [29, 30]. Studies in ophthalmology, radiotherapy, and other specific settings likewise show that effective scheduling should account for real-time demand, departmental resources, patient pathways, and expected service duration [31, 32]. Appointment systems should therefore be evaluated in the context of department-specific workload and processes rather than assumed to produce uniform waiting and satisfaction advantages.

From a management perspective, an appointment is a registration and scheduling pathway, whereas actual waiting is the result patients experience after arrival. Differences in clinical capacity, clinician availability, walk-in demand, queueing rules, arrival patterns, or consultation duration may prevent appointment status from automatically translating into shorter waits or greater satisfaction. Appointment patients in ophthalmology had shorter waits and higher satisfaction than walk-in patients, whereas the groups in gynecology had similar waiting times and satisfaction. Although this pattern suggests that appointment-related experience may be context

dependent, the study did not directly measure staffing, workload, clinical complexity, clinician schedules, or queueing rules and therefore cannot identify the operating mechanism responsible for the difference.

The study reframes the question from whether appointments are associated with greater satisfaction on average to whether the appointment process creates perceptible operational value within a specific department. Appointment use, appointment punctuality, and appointment-related waiting advantage are conceptually distinct. A department may have high appointment use and punctuality without appointment patients experiencing a clear waiting or satisfaction advantage over walk-in patients. Appointment status or use alone may therefore be insufficient as a measure of patient-centered service performance.

Hospital managers may benefit from evaluating appointment services at the department level and jointly monitoring appointment use, actual waiting time, appointment punctuality, the waiting-time gap between appointment and walk-in patients, expectation fulfillment, and department-specific satisfaction. If a department has high appointment use but no corresponding waiting or satisfaction advantage, managers could review demand-capacity alignment, appointment templates, clinician schedules, arrival patterns, queue management, and how waiting-time expectations are communicated. These suggestions identify priorities for process review and do not represent causal estimates of any specific intervention.

Limitations

This study has several limitations. First, it was conducted in only two outpatient departments at one hospital, limiting generalization. Second, the extracted dataset did not include clinical status, disease complexity, service provider, staffing, workload, patient arrival time, queueing rules, or complete information about the response process. These unmeasured factors may have been associated with appointment status, waiting performance, and satisfaction, leading to residual confounding. Third, all participants in the gynecology sample were female, whereas the ophthalmology sample included both female and male patients. This structural difference, arising from the populations served by the departments, limits the comparability of sex across departments.

Conventional covariate adjustment cannot fully eliminate the resulting confounding or model-extrapolation concerns.

Conclusions

Appointment patients reported greater satisfaction with waiting than walk-in patients in ophthalmology, but no corresponding advantage was observed in gynecology. This departmental difference co-occurred with a more pronounced appointment-related reduction in actual waiting time in ophthalmology. Among appointment patients, satisfaction was also strongly related to whether actual waiting exceeded expected waiting, whereas expected-call position relative to the scheduled window was not independently informative after accounting for actual and expected waits.

Appointment status alone may therefore be insufficient as an indicator of patient-centered service performance. Department-specific actual waiting, expectation fulfillment, and satisfaction should be evaluated together. Because this study was observational and did not comprehensively measure operating mechanisms, the findings should be interpreted as associations and departmental heterogeneity rather than causal effects of appointments, waiting performance, or expectations.

List of abbreviations

CI: confidence interval; HC3: Heterosexuality consistent covariance estimator type 3; OLS: ordinary least squares; SPSS: Statistical Package for the Social Sciences.

Declarations

Ethics approval and consent to participate

Before data collection, the study protocol was submitted to the Ethics Committee of The Second Affiliated Hospital of Zhejiang Chinese Medical University. The committee determined that the minimal-risk, non-interventional questionnaire study was exempt from ethical review. All procedures were conducted in accordance with the Declaration of Helsinki and relevant institutional requirements. Informed consent was obtained from all participants.

Consent for publication

Not applicable.

Availability of data and materials

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

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

All authors contributed to the design of this study. The data was prepared by YY, JZA and ZL. Statistical analysis was performed by GKX. The first draft of the manuscript was prepared by ZH. All authors reviewed and edited the manuscript. All authors read and approved the final version of the manuscript submitted for publication.

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