Ostadmohammadi *et al.*
BMC Health Services Research (2025) 25:220
https://doi.org/10.1186/s12913-025-12289-5

BMC Health Services Research

RESEARCH

Open Access

Stakeholders' experiences, perceptions and satisfaction with an electronic appointment system: a qualitative content analysis

Faezeh Ostadmohammadi[1], Ehsan Nabovati[2], Fatemeh Rangraze Jeddi[2] and Leila Shokrizadeh Arani[2*]

Abstract

Background Online appointment scheduling systems have been designed and implemented to address barriers and problems related to in-person appointment scheduling; however, these systems also face challenges and issues that require continuous evaluation and resolution. This research aimed to investigate the experiences, perceptions and satisfaction of stakeholders with an electronic appointment system and identify its problems.

Methods This was a qualitative study conducted at a specialty Clinic in Iran during 2022–2023. A systematic purposive sampling method was used to select the participants. The participants included 10 administrative and executive users working at the Specialty Clinic, 8 physicians working at the clinic and 18 patients and visitors to the clinic. Data was collected through semi-structured face-to-face interviews. The interviews were analyzed using qualitative content analysis.

Results The findings derived from the semi-structured interview data revealed that the problems with the appointment system fell into two main themes: "Problems Related to Planning and Management of the Electronic Appointment System" and "Non-managerial Problems of the Electronic Appointment System". The problems related to planning and management were divided into three categories: national-level system management, university-level system management and clinic-level system management. The non-managerial problems were classified into two groups: functional problems and non-functional problems.

Conclusions The results of this study showed that the electronic appointment system, despite facilitating appointment processes, can be influenced by various factors and lead to stakeholder dissatisfaction. Planning, management and policymaking have a significant impact on the appointment process of healthcare centers and attention to the problems arising from it is of particular importance. Moreover, if the functional and non-functional requirements of appointment systems are unclear, the system will face many challenges.

Keywords Content analysis, Qualitative research, Problems, Appointments and schedules

Introduction

Increasing numbers, diversity and severity of diseases among outpatients have made their services an increasingly important part of the healthcare system in recent decades [1, 2]. It emphasizes the importance of referral management for improving the effectiveness and efficiency of outpatient services [3, 4]. Scheduling a patient's appointment is one of the most important parts of

*Correspondence:
Leila Shokrizadeh Arani
Shokrizadeh-L@kaums.ac.ir
[1] Student Research Committee, Kashan University of Medical Sciences, Kashan, Iran
[2] Department of Health Information Management and Technology, School of Allied Medical Sciences, Kashan University of Medical Sciences, Kashan, Iran

patient workflow management, since it requires attention to three important aspects of the service process, patient arrival and scheduling [5]. Research has indicated that arranging in-person appointments can result in several issues, including poor service quality, extended waiting periods and inefficiencies for both physicians and patients [5–7], forgetting appointments, long queues of patients, stressful situations for clinic staff and a significantly high frequency of these occurrences can lead to various challenges [8–11]. Ultimately, these factors may result in stakeholders' dissatisfaction [5–7, 11, 12].

Online appointment systems have been developed and implemented in order to address obstacles and issues associated with traditional appointment systems [13, 14]. Patient waiting times can be minimized by appointment scheduling systems [15–17]. These systems allow customers and clients to quickly and conveniently book appointments and make reservations [18], They reduce the variability in when patients arrive [19] and improve overall patient satisfaction [16, 19]. Additionally, these systems achieve a uniform and fair distribution of work during working hours [20]. Moreover, they have improved patients' access to health services [18]. Studies have shown that using an online appointment scheduling system significantly affects stakeholders' satisfaction [20–23].

In spite of the fact that online appointment scheduling systems can lead to positive outcomes, they are not without their own problems and challenges [14, 24–28]. A web-based appointment system faces the unavoidable issue no-shows, which is a persistent and costly problem in healthcare [15, 29]. According to various studies, no-shows account for approximately 10% of all medical appointments [30, 31]. According to the various studies, problems of online appointment scheduling systems can be categorized into six main categories: technical issues (system crashes lead to missed appointments) [9, 32, 33], security concerns (hacking exposes patient data) [34–37], user interface problems (complex navigation causes booking abandonment) [9, 12, 22, 38–41], communication issues (delayed confirmations lead to wrong arrivals) [15, 41, 42], management challenges (overbooking from poor slot management) [41, 43–45] and economic factors (high scheduling costs without benefits) [32, 42]. These problems can have many consequences for clinics, providers and patients.

In addition to these problems, patients with urgent needs are adversely affected by the lack of timely and convenient appointment slots. Frequent cancellations of appointments and long wait times can lead to patient dissatisfaction. Additionally, physicians may also be affected when a patient fails to show up for an appointment despite receiving an electronic appointment schedule. These factors can affect clinicians' income and job satisfaction [46]. One of the solutions to reducing the problems of the online appointment system is to ensure accuracy in the system design and evaluation. To design these systems, three key factors must be considered: system characteristics, care receiver characteristics and policies regarding service provision. Inattention to each part can result in problems [1].

Users' perspectives are important and noteworthy when evaluating online appointment system. It is impossible to evaluate an online appointment system without analyzing how its users perceive it [47]. In order for an online appointment system to be appropriate and robust, stakeholders must be satisfied [48]. In contrast, stakeholders differ in their understanding and experience, which results in varying levels of stakeholder satisfaction [49, 50]. In order to get a deeper understanding of the system stakeholders, a qualitative study can be conducted. The qualitative method provides a depth of information and a richness of detail. In qualitative studies, stakeholder satisfaction and attitudes toward the system are accurately demonstrated. As a result, system problems can be identified more effectively [51]. Numerous qualitative studies have assessed users' experiences with information systems, emphasizing the need for this study [52–55]. Numerous qualitative studies have assessed users' experiences with information systems, highlighting the need for our research [52–55]. While many have studied healthcare information systems, few focus specifically on online appointment scheduling. Our study explores issues from all three stakeholder perspectives and examines both management and non-management aspects. Previous research has noted user dissatisfaction due to technical problems and poor communication, but the broader impacts on patient care and clinic efficiency remain underexplored. Our study aims to address these gaps and clarify its significance in the literature.

The aim of the study

The purpose of present study was to investigate the experiences, perceptions, and satisfaction of stakeholders with an electronic appointment system (24-Paziresh). The present study was led to the identification of problems related to the system and how to use it, which will help the clinics' administrators and the developer in upgrading the system.

Methods

Study design

We conducted a qualitative study in 2022 to investigate how stakeholders perceive and feel about the 24-Paziresh system, by using conventional content analysis methodologies. In this method, the manifest and latent contents

of experiences are identified, coded, summarized and categorized. The 24-Paziresh system is an electronic appointment scheduling platform utilized in over 200 clinics across Iran. Its primary functions include:

- Appointment booking: Users can schedule medical appointments through the web, mobile app or phone.
- User roles: The system serves patients, healthcare providers and administrative staff.
- User interaction: Patients book appointments and manage schedules; providers manage slots and patient lists; administrative staff ensure smooth operations.

Setting

The current research was carried out at an outpatient clinic run by the government that is associated with Kashan University of Medical Sciences (Akhavan Clinic) located in Iran. In this clinic, there are 12 treatment units and about 40 specialized and sub-specialized clinics. In this clinic, laboratory and rehabilitation services are also available. Every day, more than two thousand people receive outpatient care at this clinic. This clinic uses the 24-paziresh system to schedule appointments electronically. In Iran, universities of medical sciences operate various clinics that utilize the 24-paziresh system for online appointment scheduling. Decisions regarding the management of these clinics are made at different levels: some are determined at the clinic level, others at the university level and some at the national level by the Ministry of Health and Medical Education, which oversees all medical universities in Iran.

Sampling

The study population (stakeholders) includes:

- Patients and clients of the Akhavan outpatient clinic who book appointments on 24-Paziresh. A patient is an individual who has made an appointment for themselves and is seeking medical services. In contrast, a client refers to someone who is booking an appointment on behalf of another patient, often becoming involved in the online scheduling process.
- Physicians who provide medical services to patients in the clinic and utilize the appointment system to manage their schedules and patient interactions.
- Administrative and executive users working in the clinic such as secretaries, managers and IT specialists. These are the staff members who manage and operate the electronic appointment scheduling system within the clinic.

The participants in this study were selected using a systematic and purposive sampling method. Inclusion criteria for the study are as follows:

- It is necessary for individuals to have prior experience using the appointment system and to be at least 18 years of age.
- Having a minimum of six months of experience working at the clinic for physicians.
- Administrative and executive users must possess a high school diploma and six months experience with the appointment system.

Data collection

Semi-structured interviews were used to collect data. The study objectives were fully explained to the participants before the interviews. The interviewers (F.O. and L.Sh.) were skilled at both communicating and interviewing. Both interviewers were women, one with a Master's degree in Health Information Technology working at a hospital and the other with a Ph.D. in Health Information Management and a university lecturer. Interview guide questions were derived from the relevant studies for the current research [22, 41]. We reviewed studies that explored user experiences with electronic appointment systems, focusing on themes such as user satisfaction, perceived efficiency and system usability. Key examples include previously published qualitative research that detailed direct feedback from users regarding their interactions with appointment systems, highlighting common pain points and suggestions for improvement. After preparation, two experienced members of the Kashan University of Medical Sciences faculty members were given this guide before the interviews were conducted to approve the questions (additional file1). In-depth interviews were conducted face-to-face with the interviewees. In both clinic and workplace settings, we planned interviews based on the opinions of the participants. Interviews lasted between 15 and 60 min. The interview would begin with obtaining consent and agreement from the interviewee, followed by an introduction of the study's purpose and the interviewer. The interviewee would then proceed with demographic questions to continue the interview. The interviewee had the right to discontinue the interview at any time they wished. Next, the interviews focused on the main topics of the study, including providing information regarding stakeholders' and users' experiences, satisfaction with the system, problems that exist and how to address them.

Follow-up questions and sentences were used by the researcher to manage the interviews, such as "Please elaborate" and "What do you mean?" We conducted

interviews until saturation was reached. A smart phone was used to record interviews with the consent of the interviewees. Immediately following the interview sessions, the sentences were transcribed verbatim. In order to identify the sub-themes and main themes, the researcher listened to the interviews multiple times, read the transcriptions multiple times and then coded and extracted meaning units. We used the COREQ tool, a 32-item checklist developed by Tong and colleagues, for conducting and writing the qualitative study [56].

Data analysis

Graneheim and Lundman's conventional content analysis approach was used for data analysis [57]. The first step was to verbatim transcribe all interview recordings and to reread them a few times to better understand each participant's perspective and meaning. As a second step, meaningful words, sentences, and paragraphs were extracted from the interview text and three coders coded the data. As a third step, the coded material was grouped according to similarity and difference and themes were identified. Following that, broad themes were defined based on the previously deduced themes and grouped categories and subcategories were formed based on the themes. Additionally, a fourth researcher was present in these discussions to provide an objective perspective and facilitate resolution of any disagreements. As part of data analysis, the researchers continuously compared their emerging interpretations with existing data and findings to improve their quality.

Trustworthiness

Data quality was ensured by ensuring credibility, transferability, dependability and confirmability according to Guba and Lincoln [58] (Table 1).

Ethical considerations

The current study was approved by the Ethics Committee of Kashan University of Medical Sciences, (ethical code: IR.KAUMS.NUHEPM.REC.1401.003). Participation in this study was voluntary and participants could withdraw at any time. After describing the study's purpose and methods, participants provided verbal and written informed consent. With the participant's permission, the recording began before the interview. A confidentiality agreement was provided prior to participation, saying that participants' words would only be used for study and that no names or other identifying information would be included in the results. Our findings were reported honestly and the data was managed confidentially. Aside from that, participants were assured their data would be used only for research purposes. In the end, we will destroy all Microsoft Office Word documents containing audio and text transcriptions.

Results

There were 36 participants in the study, including ten administrative and executive users working in the Clinic and Healthcare Department of Kashan city, eight physicians working in the clinic and 18 patients and clients. None of the participants withdrew from the study. In Table 2, participants' characteristics are summarized.

An analysis of the interviews yielded a total of 83 initial codes, 29 subcategories, five categories and two themes that reflected the problems with the appointment system based on the perspectives of the stakeholders. The two extracted themes were: "Management and planning problems" and "Non-administrative drawbacks and issues". All categories, subcategories and relevant participant quotes relating to the aforementioned themes were presented separately in Tables 3 and 4.

Management and planning problems

Proper planning and management of processes is one of the most critical factors for organizational and managerial success. The vast majority of participants stated that improper planning and poor management of processes at different levels was one of the reasons that led to problems with appointment scheduling. Three categories emerged under the theme of management and planning problems: "Management and planning (national level)", "Management and planning (regional level)" and "Management and planning (organizational/ enterprise level)" (Table 3).

Table 1 A study's trustworthiness

Criteria	Method
Credibility	Credibility was established by checking members, immersing participants in the data, and selecting samples with maximum variation
Dependability	Dependability was ensured by peer-review. To ensure that the analysis of the data was accurate, two qualitative researchers independent of the study conducted peer reviews
Transferability	Data collection, analysis, and findings have been described in detail in order to ensure transferability so other researchers can relate them to their experiences. A vigorous presentation of the results and quotations enhances the transferability of the study
Confirmability	A confirmation of the findings was done by sending the results to the participants, who confirmed they could represent their true experiences

Table 2 Demographic data of the participants (n = 36)

Characteristics of participants	N (%) or M ± SD
Participants	
Administrative and executive users	10 (27.78)
Physicians	8 (22.22)
Clients and patients	18 (50)
Administrative and executive users gender	
Male	5 (50)
Female	5 (50)
Physicians gender	
Male	5 (62.5)
Female	3 (37.5)
Clients and patients gender	
Male	5 (27.78)
Female	13 (72.2)
Administrative and executive users age	39.5 ± 7.13
Physicians age	41.25 ± 5.85
Clients and patients age	37.39 ± 9.77
Administrative and executive users education	
Diploma and under diploma degree	2 (20)
Associate degree	4 (40)
Bachelor's degree	2 (20)
Master's degree	1 (10)
Professional degree	1 (10)
Specialty of physicians	
Specialist	6 (75)
Sub specialist	2 (25)
Clients and patients education	
Diploma and under diploma degree	10 (55.55)
Associate degree	1 (5.56)
Bachelor's degree	6 (33.33)
Master's degree	1 (5.56)
Work experience of Administrative and executive users	11.8 ± 8.35
Work experience of Administrative and executive users in the clinic[a]	2.75 ± 0.92
Clinical experience of physicians	9.12 ± 7.37
Clinical experience of physicians in the clinic	2.43 ± 0.77
Applying the system in the office by physicians	
Yes	2 (25)
No	6 (75)
Appointment booking method for Clients and patients	
Application	6 (33.33)
Website	2 (11.12)
IVR telephone[b]	4 (22.22)
Mixed method	6 (33.33)

[a] Experience with 24-Paziresh system at Akhavan outpatient Clinic

[b] Interactive Voice Response

Management and planning (national level)

The interviews with participants revealed several problems at the organizational/enterprise level, including "Human resource distribution issues", "Unfair distribution of amenities", "Incompetence of organizational control policy to address issues caused by the behaviors of clients" and "Inadequate and inappropriate technical support".

Based on participant experiences, the shortage of specialist physicians at government clinics and weak policies to recruit and employ them contributed to appointment scheduling problems (Table 3, quote 1).

Participants believed some clients lack access to smartphones or the Internet, preventing fair use of amenities by all people (Table 3, quote 2).

According to participants, some clients disregard punctuality and have low information technology knowledge and inappropriate attitudes towards its use (Table 3, quote 3, 4).

A key feature of purchased systems is strong technical support from the contractor regarding problems. However, managers and physicians emphasized poor support and inaccurate responses from the 24-Paziresh contractor's technical team about system issues (Table 3, quote 5, 6).

Management and planning (regional level)

Some planning and decisions made by senior managers created problems in the appointment scheduling process. Interviews with participants revealed issues including "Insufficient notification and education process", "Executive problems implementation of electronic referral system", "Executive problems in implementation phase in appointment scheduling processes", "Weakness in the management of financial processes", "Problems regarding the access level for physician", "Infrastructure problems" and "Insufficient control and supervision on physicians' schedule".

According to participants, insufficient notification and weak training on the capabilities of the system were additional factors in appointment problems. For example, some participants complained about not being informed about new or removed physicians (Table 3, quote 7). Participants also felt notification to clients about online consultations and visits was inadequate.

The improper implementation of the electronic referral system led to inappropriate use of medical and diagnostic services due to low costs at public clinics, insufficient client knowledge in choosing a relevant physician and unnecessary appointment bookings by some clients (Table 3, quote 8).

Participants were dissatisfied with the frequent changes to appointment times and dates and the system not being active 24/7 for booking. The addition of processes to get appointments and parallel work from the

Table 3 Management and planning problems of the appointment system

Categories	Subcategories	Example Quotes	In-text Identifier
Management and planning (national level)	human resource distribution problems	*From my perspective the core issue faced by public healthcare is not the appointment scheduling system, but rather the challenge of recruiting specialist physicians to work in government-run clinics, according to an administrative executive. This shortage of specialist physicians willing to join state medical facilities is attributed to the relatively low medical service fees imposed by public health authorities (Administrative and executive user)*	1
	Unfair distribution of amenities	*A proportion of patients situated in rural, remote and underprivileged areas may lack access to internet and mobile phone services, rendering them unable to directly schedule appointments through the digital system. In such cases, the clinic administration coordinates appointment bookings on behalf of these patients to guarantee access to care (Administrative and executive user)*	2
	Incompetence of organizational control policy to address issues caused by the behaviors of clients	*While the appointment scheduling system has merits, its utility is limited by issues of system literacy and complexity, particularly for elderly and illiterate populations, Even reportedly technologically literate users sometimes encounter difficulties navigating the system. This indicates potential barriers to efficient use of the platform across all demographic groups (client and patient)*	3
		Some patients fail to present punctually for booked appointments, disrupting scheduling coherence. If appointments are not provided to such individuals upon demand, aggressive behaviors may ensue. This suggests issues of patient accountability as well as suboptimal civic etiquette when accessing public health services (Administrative and executive user)	4
	Inadequate and inappropriate technical support	*The appointment scheduling system support is ineffective and the support team does not respond appropriately to resolving issues. During the Covid-19 pandemic, when problems like appointment disruption and system outages occurred, the support team did not provide adequate responsiveness (Administrative and executive user)*	5
		The ability to upload profile pictures, add biographies, or enable online visits has remained inaccessible despite repeated contact with technical support, reflecting poor system responsiveness overall (physician)	6
Management and planning (regional level)	Insufficient notification and education process	*The application lacks notifications when new physicians join or depart clinics, leaving users unaware of changes in provider availability. Incorporating prompts that alert users to additions and removals of clinicians could improve system utility (Patient or Administrative and executive users)*	7

Table 3 (continued)

Categories	Subcategories	Example Quotes	In-text Identifier
	Executive problems implementation of electronic referral system	*The electronic referral system implementation in the country remains suboptimal. Proper execution could potentially resolve many healthcare issues. Cheap services may obfuscate true value to consumers, prompting inappropriate medical and diagnostic service utilization (Administrative and executive users)*	8
	Executive problems in implementation phase in appointment scheduling processes	*The electronic appointment system engenders patient dissatisfaction by necessitating dual booking through the 24-h reception system and onsite appointment kiosks, per one physician. While potentially advantageous if streamlining processes, adding steps will inhibit adoption. In my opinion the, the appointment scheduling system has thus far failed to align with public needs, risking unsuccessful implementation (physician)*	9
	Weakness in the management of financial processes	*Online payment capabilities exist within the appointment scheduling system but have not been activated due to legal impediments, such as refund logistics for no-shows, and policies limiting telephonic financial transactions (Administrative and executive users)*	10
		The appointment scheduling system online payment feature enabling appointment deposits should be activated to improve booking accountability, per one respondent. This functionality currently operates in other regions but not locally, allowing reservation of appointment slots without obligation. This limits access for other patients when the booker is a no-show (physician)	11
	problems regarding the access level for physician	*Government clinic physicians cannot directly access the appointment scheduling system presently; modifications instead occur* via *management. Direct access would enable viewing medical feedback, personal profiles, and usage statistics (Physicians)*	12
	Infrastructure problems	*When I call the IVR at the appointed time to make an appointment, the phone lines are continuously occupied. After two or three minutes when the phone is connected, the appointments are over (client and Patient)*	13
		The clinic has a limited number of phone lines (30) for booking appointments. This number does not match the number of physicians at the clinic. As a result, patients must know the best times to call in order to successfully book an appointment over the phone (Administrative and executive users)	14
	Insufficient control and supervision on physicians' schedule	*Some physicians at the clinic do not have set work schedules and may arrive late. For example, if a physician is scheduled to arrive at 5pm, the appointment scheduling system books patients based on that timing. However, the physician could arrive late due to an emergency patient. This causes appointments to be delayed, leading to patient dissatisfaction and complaints (Administrative and executive users)*	15

Table 3 (continued)

Categories	Subcategories	Example Quotes	In-text Identifier
Management and planning (organizational/Enterprise)	Inconsistency of executive plans developed in the clinic	*A key issue in this appointment scheduling system is aligning appointment times with physician schedules. For instance, some physicians arrive at the clinic at 6pm, but patient appointments start at 4pm. This causes patients to experience delays that make them angry. Patients often argue with staff and sometimes shout due to their frustration. It would improve the situation greatly if the appointment system could match appointments to the physicians' actual work hours and presence in the clinic (Administrative and executive users)*	16
		The appointment system should schedule bookings based on the times provided by each physician. Currently, the first and last appointments of the day are at the same times across physicians. This results in a large influx of patients arriving at the clinic simultaneously, such as between 6 to 8pm when it becomes extremely crowded. It would be better if appointments were staggered throughout the day based on individual physician schedules to prevent congestion (Administrative and executive users)	17
	Absence of supervisory plan in the clinic related to authentication	*One issue encountered is that some patients book appointments using random national ID codes that don't belong to them. In the past, the clinic wouldn't register these patients in the health information system (HIS) due to the mismatched IDs. However, since the COVID-19 pandemic began, the clinic has had to relax enforcement around ID verification during appointment registration due to other problems (Administrative and executive users)*	18
	Poor management of the appointment process	*I find that all of a physician's appointment slots can be booked up within one minute. My belief is that clinic staff are reserving appointments for their family members and friends, filling up the availability. I hope this issue of favoritism in scheduling appointments can be addressed and resolved by the appointment system (client and patient)*	19
		When patients book appointments through the system, they do not always understand the exact timing of the appointment slot they are reserving, such as whether it is an evening or next morning appointment (physician)	20
	Incomplete registration of physicians' schedule	*On some occasions, patients have reported to a physician that the appointment scheduling system notified them the physician was off or on leave that day, when the physician was in fact present at the clinic and not scheduled to be absent. The physician believes such incorrect notifications originate from issues on the clinic management side rather than with the appointment system functionality itself (physician)*	21

Table 3 (continued)

Categories	Subcategories	Example Quotes	In-text Identifier
	Users access level problem	*I am unable to access the appointment scheduling system directly or receive notifications when patients cancel appointments. The admissions and information staff have system access, but my role does not. I've had to create a manual list to track appointments by billing number. Facilitating system access for roles like mine would enable easier appointment management (Administrative and executive users)*	22

Table 4 Non-administrative drawbacks and issues of the appointment system

Categories	Subcategories	Example Quotes	In-text Identifier
Functional	Alerts & Notifications	*A feature of the 24-Paziresh system is offering alternative appointment times if the desired time is full. I once selected one of the suggested times to book with my preferred physician, but the spots were taken very quickly. It would be helpful if there was an indication of how many appointments were left for a given time slot. Knowing the remaining availability, I would have booked the first opening I was offered rather than missing out (client and patient)*	1
		I once checked the 24-Paziresh app at my appointment time, and it showed no availability. However, appointments could still be booked through the website and phone. There should be an alert notifying users across all platforms when appointments are fully booked, rather than just showing full on one platform. This would prevent people from assuming appointments are still available on other channels when they are actually filled. A consistent notification that slots are taken across booking methods would improve the user experience (physician)	2
	Accessibility	*Users can currently cancel booked appointments in the system, but they can't delete the record of past appointments from their history. For instance, if I booked an appointment and then canceled it or just didn't show up, I'm unable to remove it from my profile later. I may want certain appointments deleted so they are not visible in my history to others. The system should allow users to delete old canceled or missed appointments from their records if desired (client and patient)*	3
	SMS reminder /Text Messages	*On a few occasions when booking appointments through the 24-Paziresh website, I didn't enter my mobile number and wasn't prompted for it. As a result, I never received a text confirmation that the appointment was scheduled (client and patient)*	4
	The phone appointment scheduling	*The phone appointment booking system does not allow going back to prior steps, so users must either start over from the main menu or hang up if a physician has no availability. Hanging up results in losing any progress made. The suggestion is implementing a phone menu guide allowing navigation between steps, rather than forcing linear progression. This would prevent losing appointments partway through booking and streamline the phone booking process overall (client and patient)*	5
	Appointment scheduling process	*Patients report difficulty booking appointments even when physicians do not have a cap on appointment slots. Despite no limited availability, patients are still unable to schedule at preferred times. Resolving this issue of appointments showing full when capacity remains would significantly improve the user experience (Administrative and executive users)*	6
	Bonus and penalty	*High patient demand makes booking appointments difficult at certain times. The suggestion is to implement a system that tracks users' unsuccessful appointment attempts within a given timeframe. Those who fail to book after multiple tries could earn priority points/bonuses to get preferential access for their next booking. This would help ensure patients who struggle to schedule appointments due to high demand are able to book future slots more easily. (Client and patient)*	7
	Poll	*The suggestion is to implement moderation of appointment feedback comments before public posting. Some comments are irrelevant or ambiguous. For instance, a complaint about not receiving an urgent same-day appointment when emergency departments are appropriate in those cases. Some comments also contradict the satisfaction rating, like praising the physician but accidentally choosing the "dissatisfied" option, skewing the score. Since patients focus more on the percentage than comments, this misrepresents physician performance. The recommendation is to screen comments to ensure they match the rating and are relevant to improve accuracy of physician evaluations. (Physician)!*	8
	System update	*Some clinic staff who updated to the newest 24-Paziresh app version reported being unable to book appointments at all due to the system freezing during the process. However, I was still able to successfully book appointments using an old unmodified version of the app. This indicates issues with the recent app update leading to system failures and appointment booking malfunctions for users who have installed the latest version. Those who avoided the update do not experience these severe connection problems and appointment booking failures. (Administrative and executive users)*	9
		Recent search updates made finding desired clinics and physicians much harder. Changing default locations is confusing and wastes time (client and patient)	10

Table 4 (continued)

Categories	Subcategories	Example Quotes	In-text Identifier
	Automated Patient Recall System	*A problematic issue was the automated patient recall system for lab appointments. Patients have 30 min to obtain an appointment from the kiosk after arriving. However, patients who arrived earlier but booked appointments with later numbers would get called sooner than those with earlier appointment numbers who booked later. This, along with appointment cancellations, led to confused appointment notifications and sequencing. The inconsistent recalls caused frustration towards clinic staff and patient dissatisfaction (Administrative and executive users)*	11
	Authentication	*It is currently possible to book appointments using someone else's national ID number and not attend the booking. If that ID number is then blacklisted, it could penalize the innocent ID holder when they genuinely need care. The suggestion is to implement stronger patient authentication in the system to validate real user identities, preventing abuse of others' ID numbers for no-show appointments. This would ensure each patient can only book appointments under their own verified ID number (Administrative and executive users)*	12
Non-Functional	User-friendliness	*The current design of the satisfaction survey is unclear and leads to user errors. The recommendation is to redesign the survey with more explicit and understandable response options. For instance, if using a star rating system, the number of stars should be labeled to avoid patients selecting the wrong option by mistake. The goal should be a simplified and unambiguous survey interface to capture accurate patient feedback (physician)*	13
		I really like to change the color of the app or change its font. If this is possible for us, it will be great (client and patient)	14
	Quick load times	*During periods of high user traffic, the appointment booking page becomes very slow. For example, at 10am when demand is typically high, the page freezes and remains unresponsive for up to a minute before loading. This indicates the system struggles to handle the influx of appointment requests at peak times, leading to delays in accessing and booking appointments (client and patient)*	15
	Integration	*The appointment slots for each physician are divided between the app, website, and phone. The app and website appointments fill up quickly due to easier access, while phone appointments remain open. The suggestion is to allocate slots based on first-come-first-served across all booking methods. So regardless of whether a patient books through the app, website, or phone, appointments would be assigned in order as patients reserve them. For instance, if 100 appointment slots are available for a physician, those slots should be filled sequentially by patients as they book appointments through any method, rather than designating specific slots only for app, website, or phone bookings separately. (Administrative and executive users)*	16
		On one occasion, I confirmed an appointment in the 24-Paziresh app at the scheduled time, which marked the appointment as completed in the system. However, when attempting to make the same appointment through other methods like the website or phone, the appointment was still shown as available for booking by other clients (physician)	17
		If the 24-Paziresh system were integrated with the Hospital Information System (HIS), many tasks would become easier. For example, when a patient enters their national ID number into the 24-Paziresh system that ID would automatically populate in the HIS, eliminating the need to manually obtain a bill from the kiosk. One reason online payments have not yet been implemented is because the 24-Paziresh and HIS systems remain disconnected (Administrative and executive users)	18

"Re-appointment kiosk" also caused problems (Table 3, quote 9).

According to some participants, Kashan University of Medical Sciences (KaUMS) disrupted text messaging to clients by not paying SMS fees to the telecom company. Also, online payment in the appointment scheduling system was not activated for users due to organizational policies and management decisions (Table 3, quote 10, 11).

One challenge physician emphasized was lacking access to the appointment scheduling system to view profiles, patient lists and client comments/feedback (Table 3, quote 12).

Parallel management of the system by the contractor and Vice Chancellor of treatment (KaUMS) caused issues like differing time slots, disrupted messaging due to telecom infrastructure and insufficient phone lines (Table 3, quote 13, 14).

Participants indicated physicians had fewer scheduled appointments than patient requests. Some physicians only saw specific patients and no electronic system

existed for booking appointments outside these lists. Tardy physicians also delayed all appointments (Table 3, quote 15).

Management and planning (organizational level)

Government clinics and outpatient centers are vital components of the outpatient healthcare delivery system. Effective management is critical. Participant experiences revealed management issues with the system at the clinic level, including "Inconsistency of executive plans developed in the clinic", "Absence of supervisory plan in the clinic related to authentication", "Poor management of the appointment process", "Incomplete registration of physicians' schedule" and "Users access level problem".

Accurately defining and adjusting physician appointment schedules in the system is essential. Unfortunately, most participants, especially secretaries and patients, faced inconsistencies between scheduled appointments and physicians' schedules (Table 3, quote 16, 17).

Reception and information staff use various methods to avoid entering mandatory items like national codes. No oversight exists to ensure national ID codes in the appointment system match those in the HIS system (Table 3, quote 18).

Some clients perceived favoritism in appointment scheduling. Others felt clinic technicians illegally occupied system appointments (Table 3, quote 19). Participants were not notified about canceled appointments to reschedule. Notification about appointment times was also insufficient (Table 3, quote 20).

One issue raised by physicians was incomplete registration of their appointment schedules (Table 3, quote 21).

Clinic staff, including secretaries and cashiers, unfortunately cannot access the electronic appointment system per participant experiences (Table 3, quote 22).

Non-administrative drawbacks and issues

The non-administrative disadvantages and problems of the appointment scheduling system were categorized into functional and non-functional (Table 4).

Functional problems

Functional requirements are product capabilities that enable users to perform tasks. They characterize system performance under defined conditions [59]. Stakeholder difficulties utilizing the system stemmed from alerts & notifications, accessibility, SMS reminder /Text messages, the phone appointment scheduling, appointment scheduling process, bonus and penalty, poll, system update, Automated Patient Recall System and authentication. This resulted in dissatisfaction with the appointment scheduling system.

Inadequate alerts about system capabilities and incorrect notifications complicated appointments for participants (Table 4, quote 1, 2).

Some participants mentioned limited ability to edit profiles (Table 4, quote 3).

Based on some experiences, phone numbers are not mandatory in the appointment scheduling system, causing messaging problems (Table 4, quote 4).

Participants cited appointment issues on the phone, including lengthy processes, inability to go back, lack of guides and non-mandatory national codes (Table 4, quote 5).

Many clients emphasized great difficulty acquiring unsuitable appointments after multiple failed attempts. They expressed irritation at being unable to adjust appointment times after booking. They also noted that patient appointments do not follow a structured sequence. Sometimes the system freezes when setting up VIP priority queues. One issue raised by secretaries was that the system sometimes does not allow appointments despite availability in the schedule (Table 4, quote 6).

According to participants, the system cannot reliably identify patients who missed appointments labeled "No-show". Therefore, it does not implement penalties for them. Additionally, there is no effective method to address clients who arrive late. The system also lacks specialized incentives designed to motivate diligent and unsuccessful users in the appointment scheduling process (Table 4, quote 7).

Physicians were dissatisfied with uncontrolled patient comments and inconsistencies between ratings and feedback (Table 4, quote 8). Clients wanted surveys about staff, which the system lacks.

After updates, participants noted hanging, search defaults changing, and filter issues (Table 4, quote 9, 10).

The improper auto-recall caused appointment confusion and notification problems for administrators (Table 4, quote 11).

Participants felt patient authentication was inaccurate and inadequate in in the appointment scheduling system (Table 4, quote 12).

Non-functional problems

Nonfunctional requirements are not related to system functionality, but rather characterize system performance [59]. Participant interviews revealed the following nonfunctional issues with the appointment scheduling system: user-friendliness, load times and integration.

User-friendly design ensures all application components function optimally and are ideally positioned so users can readily communicate with the system and comprehend key features. Admissions and information staff cited user-friendliness issues including inappropriate bill

printing icon design, which slowed their work. They also stated the SMS sending icon is activated by default for all clients unnecessarily, since in-person appointments do not require it. Some physicians believed the satisfaction survey rating scale was poorly designed, artificially and unrealistically lowering their satisfaction percentages (Table 4, quote 13). Some participants felt the system exhibited weak "Simple and intuitive interface" and "Clear and concise content", especially for users with lower digital literacy. They were also interested in changing the background color (Table 4, quote 14).

Some participants mentioned the application loading speed is very slow, especially during busy times (Table 4, quote 15). They also stated the system sometimes crashes during appointment scheduling, hangs while queuing and disrupts appointment registration in the application.

Based on participant experiences, the three appointment methods—phone, app and website—are not integrated. As a result, some appointments remain empty and unfilled (Table 4, quote 16, 17). Some participants stated the appointment scheduling system clock does not match real time. The lack of linkage between the appointment scheduling system and the HIS system also caused appointment issues (Table 4, quote 18). Some participants were interested in communicating with physicians through video software like Skype or Zoom, which the appointment scheduling system does not connect to.

Discussion

This qualitative study explored problems with an appointment scheduling system based on stakeholder perspectives. Analysis of interview data revealed two main themes: management and planning problems, along with non-administrative system drawbacks.

The management and planning of the appointment scheduling system emerged as a key issue based on the stakeholder experiences. This included challenges at the national, university and clinic levels in terms of effective oversight, strategic planning and policy implementation. The 24-Paziresh system is implemented in over 200 clinics across Iran and national policies significantly influence its utilization. For instance, the connection between the appointment system and the banking system for payment processing is crucial. The national banking policies in Iran affect the execution of online payment for consultation fees, which can hinder the system's functionality, even though it has the potential to facilitate such transactions. Although this study was conducted in a single clinic, the policies implemented by the university significantly impact the system. Each university oversees multiple clinics, and the university's policies and management practices affect the efficiency and satisfaction of the system. Furthermore, the specific policies of each clinic also influence the effectiveness of the appointment system. These connections demonstrate that the challenges identified are not limited to a single clinic but can also impact the performance of other clinics within the university network. The findings revealed that suboptimal management, planning and policymaking can significantly undermine the performance and functionality of the electronic scheduling system. This aligns with the findings by Küçük et al. that inappropriate healthcare policies were a root cause of the poor performance of an outpatient electronic appointment scheduling system in Turkey [43].

The present study aligns with the findings of other studies [43, 60, 61] regarding the challenge of uneven geographic distribution of human resources. It also echoes the issues identified by Nakhaee et al. around patient no-shows [6], as well as the concerns raised by Birru et al. and Zhang et al. about low IT literacy among some users [62, 63]. Further, the study corroborates the problems with inadequate technical support and responsiveness reported by studies [6, 33, 64, 65]. Finally, the lack of Internet access for many patients, as highlighted by some studies [22, 42, 63, 66], is also a challenge reflected in the current study. Based on the key issues identified with the electronic scheduling system at the national level, here are some recommendations for policy-level improvements:

- Strengthen national oversight and coordination such as establish a dedicated national-level committee or agency to oversee the implementation and continuous optimization of the appointment system.
- Improve geographic equity of resources
- Promote patient engagement strategies
- Enhance technical support and system responsiveness
- Invest in Digital Literacy Initiatives

Based on the participants' experiences in this study, other contributing factors to the problems in the appointment process were related to incorrect policies and planning at the university level. The findings of this qualitative study, along with aligned studies, classified the following issues in this category:

- Lack of communication and training [6, 15, 22, 63, 67]
- Non-implementation of the electronic referral system [6, 43, 68, 69]
- Weaknesses in appointment determination processes [41, 44, 67, 70, 71]
- Deficiencies in financial process management [6, 11, 71–74]
- User accessibility issues [18, 39, 75]

- Infrastructure problems [6, 9, 13, 33, 71, 76, 77]
- Lack of control and supervision over physicians' schedules [16, 71, 78]

Some of the management problems of the system at the clinic level, which was mentioned by the majority of participants in their experiences and corroborated by aligned studies, includes:

- Lack of alignment and coordination with the formulated operational plans at the clinic [71]
- Absence of a supervisory program within the clinic regarding identity verification [6, 34, 36, 37, 40]
- Inadequate management of the appointment process [6, 45]
- Incomplete recording of physician information [40, 71, 79]

Based on the issues identified at the university and clinic levels in the 24-Paziresh electronic scheduling system, here are some recommendations:

- Improve Communication and Training: Establish clear communication channels between the university administration, healthcare providers, and patients to ensure all stakeholders are informed about the system's features and functionality.
- Implement Electronic Referral System
- Strengthen Appointment Determination Processes
- Improve Financial Process Management
- Enhance User Accessibility and Infrastructure

By addressing these university-level challenges, the appointment scheduling system can be better integrated into the academic healthcare ecosystem, providing a more reliable and user-friendly experience for all stakeholders.

Functional requirements describe the system's behavior under specific conditions [59]. According to the opinions and experiences of the participants, issues such as alerts, access, messaging capabilities, telephone appointment scheduling, the appointment scheduling process, fines and rewards, surveys and evaluations, updates, the recall system and authentication were among the problems that stakeholders faced when using the appointment system.

The results of the studies [79, 80] referred to the weakness in the ability to recall the appointment time in the evaluation of online appointment scheduling systems. Studies [39, 79] emphasize that improving user access, including for both physicians and patients, to certain features of the 24-h reception appointment scheduling system can lead to increased user satisfaction with the use of this system. The results of the studies showed [6, 40, 71, 74] that providing appointment confirmation messages and reminders regarding the appointment time can lead to increased user satisfaction. The studies are consistent [6, 71, 77] with the current study in highlighting the problems with telephone appointment scheduling, such as the lengthy process, the inability to return to previous steps and menus, the lack of guidance for determining the telephone appointment and the absence of mandatory national ID number entry.

Based on the problems identified with the 24-Paziresh system and the review of similar literature, the following recommendations are proposed to resolve functional requirement problems which could enhance the effectiveness and efficiency of the system and increase stakeholder satisfaction:

- Designing and implementing a robust alert and reminder system
- Enhancing appointment confirmation and reminders
- Improving user access and navigation
- Optimizing the telephone appointment scheduling process
- Implementing user feedback monitoring and response mechanisms
- Enabling Appointment Cancellation and Rescheduling
- Improving Search Functionality and System Updates
- Addressing No-Show Issues and Incentivizing Responsible Users

Non-functional requirements describe the qualitative aspects of the system that focus on user expectations [59]. If the stated non-functional requirements are ambiguous, the team is likely to encounter significant challenges. Aspects such as usability, system integration and performance were identified as non-functional problems with the appointment scheduling system.

In contrast to the present study, which had identified issues related to user-friendliness as a problem with the system, the findings of other studies [9, 11, 12, 22] showed that most participants considered the online appointment scheduling system to be user-friendly. Additionally, Mahfouz et al. acknowledged that most visitors were satisfied with the speed of the electronic scheduling system and could easily access the application and its services [12]. Consistent with the current study, the results of others [6, 9, 11] also referred to the problem of lack of integration.

Based on the non-functional issues with the 24-Paziresh system, here are some practical recommendations:

- Enhancing usability and user experience: 1) Design the scheduling system with a strong focus on user-centered principles to improve intuitiveness and ease of use. 2) Leverage vibrant colors, larger and clearer buttons and appropriate font choices to create an engaging visual interface.
- Improving system integration and interoperability: 1) Integrate the appointment scheduling system seamlessly with the clinical information system (CIS). 2) Align the system clock with real-time to avoid confusion and improve coordination.
- Enhancing system performance and responsiveness: Optimize the system architecture and infrastructure to maintain high performance, even during peak usage periods.

Strengths and limitations

One of the strengths of the current study is that we extracted the problems of the online appointment system based on the experiences of all stakeholders. Additionally, in qualitative studies, stakeholder satisfaction and attitudes toward the system are accurately demonstrated. The present study was limited to a single outpatient clinic. It is recommended that future research be conducted on a broader scale, encompassing university-level facilities as well as private practices such as physicians' offices. Some stakeholders were hesitant to share their experiences with the research team. Additionally, the current research findings are qualitative in nature, and their generalizability to the wider society is weaker compared to quantitative research results. Consequently, it is advisable to undertake quantitative research and evaluate the usability of the 24-Paziresh electronic appointment system.

Key implications for future research include:

- Comparative studies: Compare electronic appointment systems across healthcare settings to identify best practices.
- Longitudinal studies: Assess the long-term impact of electronic systems on stakeholder experiences and challenges.
- System management: Explore how management factors influence the effectiveness of appointment systems at various organizational levels.
- Evaluation frameworks: Develop frameworks to evaluate the performance of electronic appointment systems and identify improvement areas.

Conclusion

This qualitative study revealed multifaceted challenges undermining the appointment system's effectiveness and patient satisfaction. Key issues stemmed from managerial weaknesses in physician recruitment, education, financial processing, and access controls. Technical limitations including flawed notifications, difficult appointment scheduling, and integration gaps between booking platforms also emerged. Collectively, these systemic barriers prevent the appointment system from aligning with patient needs and optimizing clinic workflows.

To actualize the potential benefits of the appointment system platform, changes are required at national, regional, organizational and system levels. Strategic physician hiring, standardized operating protocols, coordinated IT systems, and enhanced platform responsiveness can help transform appointment scheduling. Patient-centered redesign focusing on usability and flexibility would enable appointments to seamlessly fit clinical demand. With coordinated efforts to address identified managerial, technical, and usability limitations, the appointment system can effectively facilitate healthcare access through patient-driven appointment scheduling.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12913-025-12289-5.

Supplementary Material 1.

Supplementary Material 2.

Acknowledgements

The content of this article originated from a master's thesis in Health Information Technology, bearing project number 400170, conducted at Kashan University of Medical Sciences in Kashan, Iran. The authors express their gratitude to the research department at Kashan University of Medical Sciences for their support, as well as to Dr. Ahmad Hosseini, the head of Akhavan Outpatient Clinic, for his cooperation. The authors also extend their appreciation to all stakeholders who participated in this study.

Authors' contributions

E.N and L.SH.A have been responsible for the idea and the design of the study. F.O and L.SH.A performed the data collection and all authors participated in analysis and interpretation of data. F.O and L.SH.A drafted the manuscript and E.N and F.R.J have revised the manuscript. All authors had critical discussions of the manuscript. All authors have approved the final version of the manuscript.

Funding

The research undertaken for this study received funding and backing from the Research Division/Department at Kashan University of Medical Sciences under project number 400170.

Data availability

The datasets generated and analyzed in this study are not publicly available due to the principle of confidentiality. They are available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate

The study was approved by the Ethics Committee of Kashan University of Medical Sciences (IR.KAUMS.NUHEPM.REC.1401.003). Informed consent for participating in this study was obtained from all the participants before the interview sessions. Accordingly, all participants were made aware of the research objectives, the confidentiality of their personal data, and their right to withdraw from or refuse participation in the interview sessions at any time. Furthermore, all procedures were conducted in compliance with the applicable guidelines and regulations outlined in the Declaration of Helsinki.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Received: 11 August 2024 Accepted: 16 January 2025
Published online: 08 February 2025

References

1. Aeenparast A, Tabibi SJ, Shahanaghi K, Aryanejhad M. Estimating outpatient waiting time: a simulation approach. Payesh (Health Monitor). 2009;8(4):327–33.
2. Hearle K, Koenig L, Rudowitz R, Siegel JM, Dobson A, Ho S. Drivers of expenditure growth in outpatient care services. Am J Manag Care. 2003;9(1):25–33.
3. Sharp DJ, Hamilton W. Non-attendance at general practices and outpatient clinics. BMJ. 2001;323:1081–2.
4. Dunnill M, Pounder R. Medical outpatients: changes that can benefit patients. Clin Med. 2004;4(1):45.
5. Yeon N, Lee T, Jang H. Outpatients appointment scheduling with multidoctor sharing resources. In: Proceedings of the winter simulation conference; 2010. p. 3318–29.
6. Nakhaee N, Oroomiei N, Amiresmaili MR, NekooiMoghadam M, Mohammadi B, Mirzaei S, et al. Challenges of appointment fixing in private physician offices from the viewpoint of physicians and secretaries. Health Dev J. 2012;1(3):207–20.
7. Idowu AP, Adeosun OO, Williams KO. Dependable online appointment booking system for NHIS outpatient in Nigerian teaching hospitals. Int J Comput Sci Inform Technol. 2014;6(4):59.
8. Saremi A, Jula P, ElMekkawy T, Wang GG. Bi-criteria appointment scheduling of patients with heterogeneous service sequences. Expert Syst Appl. 2015;42(8):4029–41.
9. Paré G, Trudel M-C, Forget P. Adoption, use, and impact of e-booking in private medical practices: mixed-methods evaluation of a two-year showcase project in Canada. JMIR Med Inform. 2014;2(2):e3669.
10. Dusheiko M, Gravelle H. The impact of Choose and Book on outpatient appointment non-attendances. Aix en Provence: CES-HESG conference; 2012. Available from: http://www.ces-asso.org/autres-conferences.
11. Bastani P, Garavand A, Abhari S. Evaluating the e-booking system through Iranian Medical University centers 'Websites. J Health Biomed Inf. 2016;2(4):219–28.
12. Mahfouz MS, Ryani MA, Shubair AA, Somili SY, Majrashi AA, Zalah HA, et al. Evaluation of Patient Satisfaction With the New Web-Based Medical Appointment Systems" Mawid" at Primary Health Care Level in Southwest Saudi Arabia: A Cross-Sectional Study. Cureus. 2023;15(1):e34038.
13. Jones R, Menon-Johansson A, Waters A, Sullivan A. eTriage–a novel, web-based triage and booking service: enabling timely access to sexual health clinics. Int J STD AIDS. 2010;21(1):30–3.
14. Zhao P, Yoo I, Lavoie J, Lavoie BJ, Simoes E. Web-based medical appointment systems: a systematic review. J Med Internet Res. 2017;19(4): e134.
15. Cao W, Wan Y, Tu H, Shang F, Liu D, Tan Z, et al. A web-based appointment system to reduce waiting for outpatients: a retrospective study. BMC Health Serv Res. 2011;11(1):1–5.
16. Habibi MRM, Mohammadabadi F, Tabesh H, Vakili-Arki H, Abu-Hanna A, Eslami S. Effect of an online appointment scheduling system on evaluation metrics of outpatient scheduling system: a before-after multicenter-study. J Med Syst. 2019;43:1–9.
17. Rose KD, Ross JS, Horwitz LI. Advanced access scheduling outcomes: a systematic review. Arch Intern Med. 2011;171(13):1150–9.
18. Akinode JL, Oloruntoba S. Design and implementation of a patient appointment and scheduling system. Department of Computer Science, Federal Polytechnic Ilaro Nigeria. 2017;4:16–23.
19. Nazia S, Ekta S. Online appointment scheduling system for hospitals–an analytical study. Int J Innov Res Sci Eng Technol. 2014;4(1):21–7.
20. Al-Haqwi AI, Al-Shehri AM. Appointment system in primary care: opinion of consumers and providers. J Fam Community Med. 2007;14(3):99.
21. Aktepe A, Turker AK, Ersoz S. Internet based intelligent hospital appointment system. Intel Automation Soft Comput. 2015;21(2):135–46.
22. Onyefulu C. Users' views on the online appointment system and services rendered at the Health Centre of the University of Technology, Jamaica. Open Access Libr J. 2018;5(10):1.
23. Habibi MRM, Abadi FM, Tabesh H, Vakili-Arki H, Abu-Hanna A, Eslami S. Evaluation of patient satisfaction of the status of appointment scheduling systems in outpatient clinics: identifying patients' needs. J Adv Pharmaceut Technol Res. 2018;9(2):51.
24. Green J, McDowall Z, Potts HW. Does Choose & Book fail to deliver the expected choice to patients? A survey of patients' experience of outpatient appointment booking. BMC Med Inform Decis Mak. 2008;8:1–8.
25. Parmar V, Large A, Madden C, Das V. The online outpatient booking system'Choose and Book'improves attendance rates at an audiology clinic: a comparative audit. J Innov Health Inform. 2009;17(3):183–6.
26. Maifredi G, Orizio G, Bressanelli M, Domenighini S, Gasparotti C, Perini E, et al. Italian hospitals on the web: a cross-sectional analysis of official websites. BMC Med Inform Decis Mak. 2010;10:1–13.
27. Yu W, Yu X, Hu H, Duan G, Liu Z, Wang Y. Use of hospital appointment registration systems in China: a survey study. Global J Health Sci. 2013;5(5):193.
28. Gowthem SS, Kaliyamurthie K. Smart appointment reservation system. Int J Innov Res Sci Eng Technol. 2015;4(6):3985–94.
29. Alaeddini A, Yang K, Reddy C, Yu S. A probabilistic model for predicting the probability of no-show in hospital appointments. Health Care Manag Sci. 2011;14:146–57.
30. Lowes R. How to handle no-shows. Med Econ. 2005;82(8):62–5.
31. Henderson R. Encouraging attendance at outpatient appointments: can we do more? Scott Med J. 2008;53(1):9–12.
32. Niu T, Lei B, Guo L, Fang S, Li Q, Gao B, et al. A review of optimization studies for system appointment scheduling. Axioms. 2023;13(1):16.
33. Klischewski R. The challenges of e-appointment: process modeling, infrastructure, and organizational context. International Business Information Management Conference, Cairo, Egypt (December 16–18, 2003); 2003.
34. Ravi S, Mankame DP. Multimodal biometric approach using fingerprint, face and enhanced iris features recognition. 2013 International Conference on Circuits, Power and Computing Technologies (ICCPCT); 2013:1143–50.
35. Al-Shujaa A, Nabi M, Al-Maatouk Q, Al-Othmani AZ, Rahman N. A Fingerprint authentication for android-based healthcare appointment scheduling system. Int J Cur Res Rev. 2021;13(12):118.
36. Azhari NA, AbdWarif NB. A clinic appointment system with authentications for Klinik Sejahtera. Appl Inform Technol Comput Sci. 2023;4(2):1–14.
37. Hamid IRA. A secured clinic booking system with multi factor authentication. Appl Inform Technol Comput Sci. 2023;4(2):15–29.
38. Aladwani AM. An empirical test of the link between web site quality and forward enterprise integration with web consumers. Bus Process Manag J. 2006;12(2):178–90.
39. Idowu AP, Adeosun OO, Williams KO. Dependable online appointment booking system for NHIS outpatient in Nigerian teaching hospitals. AIRCC's Int J Comput Sci Inform Technol. 2014;6:59–73.
40. Taşkın B, Coşkun Hİ, Tüzün H. Usability evaluation of the mobile application of centralized hospital appointment system (CHAS). User Centric E-Government: Challenges and Opportunities. 2018:231–48.
41. Zhang M, Zhang C, Sun Q, Cai Q, Yang H, Zhang Y. Questionnaire survey about use of an online appointment booking system in one large tertiary public hospital outpatient service center in China. BMC Med Inform Decis Mak. 2014;14:1–11.

42. Zhang X, Yu P, Yan J, Ton AM, Spil I. Using diffusion of innovation theory to understand the factors impacting patient acceptance and use of consumer e-health innovations: a case study in a primary care clinic. BMC Health Serv Res. 2015;15:1–15.
43. Küçük A, Demirci M, Kerman G, Özsoy VS. Evaluating of hospital appointment systems in Turkey: challenges and opportunities. Health Policy Technol. 2021;10(1):69–74.
44. Aeenparast A, Maftoon F, Farzadi F. Identifying key variables for designing a scheduling system for outpatient appointments: A systematic review. Payesh (Health Monitor). 2017;16(6):735–45.
45. Sun S, Wang W. Violence against Chinese health-care workers. Lancet. 2011;377(9779):1747.
46. Gupta D, Denton B. Appointment scheduling in health care: challenges and opportunities. IIE Trans. 2008;40(9):800–19.
47. Hamborg K-C, Vehse B, Bludau H-B. Questionnaire based usability evaluation of hospital information systems. Electr J Inform Syst Eval. 2004;7(1):pp21-30-pp21-30.
48. Darbyshire P. 'Rage against the machine?': nurses' and midwives' experiences of using computerized patient information systems for clinical information. J Clin Nurs. 2004;13(1):17–25.
49. Denomme LB, Terry AL, Brown JB, Thind A, Stewart M. Primary health care teams' experience of electronic medical record use after adoption. Fam Med. 2011;43(9):638–42.
50. Taylor P. Team EMR. How to maximize productivity and potential for both the individual and the team. Healthc Inform. 2007;24(5):34–5.
51. Polit DF, Beck CT. Essentials of nursing research: Appraising evidence for nursing practice: Lippincott Williams & Wilkins; 2010.
52. Al Alawi S, Al Dhaheri A, Al Baloushi D, Al Dhaheri M, Prinsloo EA. Physician user satisfaction with an electronic medical records system in primary healthcare centres in Al Ain: a qualitative study. BMJ open. 2014;4(11):55–69.
53. AlKhaldi M, Abed Y, Pfeiffer C, Haj-Yahia S, Alkaiyat A, Tanner M. Assessing policy-makers', academics' and experts' satisfaction with the performance of the Palestinian health research system: a qualitative study. Health Res Policy Syst. 2018;16(1):1–11.
54. Quintanilha M, Tink L, Perez A, Go'neill M, Holt NL, Bruce A, et al. Pediatric ambulatory appointment scheduling: a qualitative study of stakeholders' perceptions and experiences. Int J Qual Health Care. 2020;32(10):643–8.
55. Begum T, Khan SM, Adamou B, Ferdous J, Parvez MM, Islam MS, et al. Perceptions and experiences with district health information system software to collect and utilize health data in Bangladesh: a qualitative exploratory study. BMC Health Serv Res. 2020;20(1):1–13.
56. Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. Int J Qual Health Care. 2007;19(6):349–57.
57. Graneheim UH, Lundman B. Qualitative content analysis in nursing research: concepts, procedures and measures to achieve trustworthiness. Nurse Educ Today. 2004;24(2):105–12.
58. Guba EG, Lincoln YS. Competing paradigms in qualitative research. Handb Qual Res. 1994;2(163–194):105.
59. Madushan HD. Online appointment management system for New Philip Hospital 2017.
60. Zurn P, Dal Poz MR, Stilwell B, Adams O. Imbalance in the health workforce. Hum Resour Health. 2004;2:1–12.
61. Song J, Qiu Y, Liu Z. Integrating optimal simulation budget allocation and genetic algorithm to find the approximate Pareto patient flow distribution. IEEE Trans Autom Sci Eng. 2015;13(1):149–59.
62. Birru MS, Monaco VM, Charles L, Drew H, Njie V, Bierria T, et al. Internet usage by low-literacy adults seeking health information: an observational analysis. J Med Internet Res. 2004;6(3):e37.
63. Zhang X, Yu P, Yan J. Patients' adoption of the e-appointment scheduling service: A case study in primary healthcare. Stud Health Technol Inform 2014;204:176–81.
64. Afrizal SH, Handayani PW, Hidayanto AN, Eryando T, Budiharsana M, Martha E. Barriers and challenges to Primary Health Care Information System (PHCIS) adoption from health management perspective: a qualitative study. Inform Med Unlocked. 2019;17:100198.
65. Valizadeh L, Bagheriyeh F, Hasani NS. Challenges and barriers of nursing information system: an integrative review. Nurs Midwifery J. 2018;15(12):874–84.
66. Macpherson E, Dhaliwal C, Richardson J. The relationship between the physical functioning of older adults and their Use of a personal health record: a systematic review. Curr Geriatr Rep. 2014;3:142–54.
67. Mishari AK, Essa SA, Muhammed AN. Introduction of an appointment system in primary health care setting in Baghdad: views of patients and health care providers. AL-Kindy College Med J. 2021;17(1):45–9.
68. Shabila NP, Al-Tawil NG, Al-Hadithi TS, Sondorp E. A qualitative assessment of the Iraqi primary healthcare system. World Health Popul. 2012;13(3):18–27.
69. Fan X, Tang J, Yan C, Guo H, Cao Z. Outpatient appointment scheduling problem considering patient selection behavior: data modeling and simulation optimization. J Comb Optim. 2021;42:677–99.
70. Vissers J. Selecting a suitable appointment system in an outpatient setting. Med Care. 1979;17(12):1207–20.
71. Bagheri F, Behnam F, Galavi Z, Ahmadian L. The use of various appointment systems among patients visiting academic outpatient centers in Kerman and the evaluation of patients' perspective and satisfaction. BMC Health Serv Res. 2022;22(1):1344.
72. Leibner G, Brammli-Greenberg S, Mendlovic J, Israeli A. To charge or not to charge: reducing patient no-show. Israel J Health Policy Res. 2023;12(1):27.
73. Garavand A, Aslani N, Ayyoubzadeh SM, Abhari S. E-booking websites in Iranian public clinics: A step toward health equity. Shiraz E-Med J. 2021;22(8):0–0.
74. Koshy E, Car J, Majeed A. Effectiveness of mobile-phone short message service (SMS) reminders for ophthalmology outpatient appointments: observational study. BMC Ophthalmol. 2008;8:1–6.
75. Silva K. Online Appointment System for Kotelawala Defence University Hospital .Sri Lanka- South Asia: University of Colombo School of Computing. 2021.
76. Online scheduling applications may improve customer satisfaction, but setup is not always easy. Internet Healthc Strateg. 2004;6(5):1-5
77. Nilchian F, Jamshidian H. Evaluation of patients' satisfaction on booking appointment system in dental school of Isfahan during 2018. 2020.
78. Aeenparast A, Farzadi F, Maftoon F, Yahyazadeh SH. Performance assessment of appointment system in managing outpatients' waiting time in a general hospital: A Case study. Int J Hospital Res. 2017;6(4):21–31.
79. Samadbeik M, Saremian M, Garavand A, Hasanvandi N, Sanaeinasab S, Tahmasebi H. Assessing the online outpatient booking system. Shiraz E-Med J. 2018;19(4):e60249.
80. Finkelstein SR, Liu N, Jani B, Rosenthal D, Poghosyan L. Appointment reminder systems and patient preferences: Patient technology usage and familiarity with other service providers as predictive variables. Health Informatics J. 2013;19(2):79–90.

Publisher's Note