BookDoc: Patient Engagement through Scheduling and Virtual Queue Optimization in Doctor Appointment Systems

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Abstract: The BookDoc project aims to improve patient engagement and simplify the process of making doctor appointments with a combined scheduling and virtual queue system. The platform provides patients with a virtual waiting room. This cuts down on physical congestion and makes it easier to access healthcare. Users can book appointments based on their preferences and availability. The system also keeps a detailed history of past consultations to ensure better continuity of care. Doctor appointments are organized clearly, which helps both patients and healthcare providers manage their time more effectively. The reminder feature lets patients receive timely notifications, reducing missed appointments and supporting adherence to treatment schedules. The chatbot provides real-time assistance by answering common questions and guiding users through the system, improving overall access. By combining these features, BookDoc offers a patient-centered solution that enhances the appointment experience, shortens waiting times, and strengthens communication between patients and doctors.

Keywords: Patient Engagement, Doctor Appointment System. Scheduling System, Virtual Queue ,Virtual Waiting Room, Appointment History, Reminders , Chatbot Assistance, Healthcare Access, Patient-Centered Solution

1 Introduction

In today's healthcare world, digital solutions are making life easier for both patients and providers. One area where this is especially true is managing doctor appointments. Long waits, missed appointments, and confusing communication have always been pain points in healthcare, but new platforms like BookDoc are changing the game.

BookDoc is designed to make booking a doctor's appointment as simple and stress-free as possible. Instead of having to call the clinic or show up in person just to get on the schedule, patients can now book appointments online for dates and times that fit their lives. This not only saves time but also means fewer headaches for both patients and clinic staff.

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A big plus of BookDoc is that it keeps a detailed record of past appointments. Doctors can quickly access a patient's history, which helps ensure consistent, high-quality care. Patients, too, can easily look back at their appointment records, which is handy for tracking treatments and follow-ups.

The platform also features a virtual waiting room. Rather than sitting in a crowded clinic, patients can wait from the comfort of home—logging in right before their scheduled time. This reduces congestion in clinics and makes the whole experience more comfortable.

BookDoc helps patients stay on track by sending timely reminders about upcoming appointments. These reminders cut down on no-shows and help patients stick to their treatment plans. If patients have questions, a built-in chatbot is there to offer real-time help, answer common queries, and guide them through the booking process. This is especially helpful for anyone who isn't tech-savvy.

By bringing together easy scheduling, appointment tracking, a virtual waiting room, reminders, and an accessible chatbot, BookDoc makes managing healthcare appointments straightforward and stress-free. It keeps communication open between patients and doctors, reduces delays, and helps avoid scheduling mix-ups. Clinic staff also benefit from having fewer routine tasks to handle, making their jobs easier.

In short, BookDoc puts patients in control of their healthcare journey while giving doctors the tools they need to provide efficient, timely care. It's a modern, user-friendly solution that tackles the common frustrations of traditional appointment systems—making healthcare more organized, accessible, and pleasant for everyone involved

2 Related works

The adoption of digital doctor appointment systems has been extensively explored in recent research, highlighting their potential to transform healthcare delivery and patient experiences. Patient portals and scheduling platforms are recognized for their role in enhancing engagement, access, and reducing inefficiencies in care pathways [1]. Systematic reviews of web-based appointment systems show that while they offer convenience and accessibility, challenges remain in terms of usability and adoption barriers [2]. A key issue in appointment scheduling is patient no-shows, which have been widely studied, with digital tools such as structured reminders and predictive algorithms offering promising solutions [3].

The integration of conversational agents and chatbots into healthcare appointment systems has also gained traction, supporting patient interaction, FAQs, and triage services [4]. Beyond scheduling, electronic patient portals contribute to appointment adherence, continuity of care, and improved utilization of primary services, thereby positively influencing patient satisfaction and engagement [5]. At an organizational level, systematic reviews show these portals improve efficiency and health outcomes [6]. In parallel, telemedicine platforms have expanded rapidly, especially during the COVID-19 pandemic, providing new opportunities but also raising challenges around accessibility, data security, and integration with scheduling systems [7], [14].

From an operational perspective, research on healthcare scheduling optimization provides strong evidence for more effective resource allocation and patient flow management [8], [15]. The use of AI-driven conversational agents has been shown to further enhance engagement,

responsiveness, and scalability of appointment systems [9]. Similarly, machine learning approaches have been applied to predict patient no-shows and optimize scheduling, showing value in improving access management and reducing inefficiencies [10], [11], [12]. Clinical perspectives confirm that virtual appointments are increasingly accepted by both patients and providers, strengthening the case for digital-first models of healthcare delivery [13].

Recent studies emphasize that electronic portals and digital scheduling tools not only transform access but also reshape patient encounters and organizational workflows [16]. Theories such as TAM and UTAUT have been applied to explain patients' acceptance of these systems, highlighting factors like ease of use, trust, and system quality [17]. More recently, stakeholder-centered research underscores the importance of user satisfaction and experiences, confirming that e-appointment systems effectively improve healthcare access, reduce waiting times, and support broader digital transformation in healthcare [18].Hypothesis 1 (H1):

When booking a doctor's appointment online is quick and easy, people are more likely to actually use the system. If the process feels simple and straightforward, users feel empowered and less anxious about managing their healthcare. This convenience encourages people to make appointments without hesitation, building trust in the system.

Hypothesis 2 (H2):

Having a detailed appointment history available gives users peace of mind and helps doctors offer better, more personalized care. Users appreciate being able to look back at previous visits or treatments, which makes them feel more involved in their own health journey. This transparency keeps users coming back for future appointments.

Hypothesis 3 (H3):

Timely reminders about upcoming appointments aren't just a nice touch—they help people remember and stick to their scheduled consultations. These reminders make it easier to keep up with treatments and reduce the risk of missing important medical visits. For busy individuals, this feature adds real value to their daily lives

Hypothesis 4 (H4):

The virtual waiting room creates a more comfortable and relaxed experience for users. Instead of spending time in crowded clinics, patients can wait from home and join exactly when it's their turn. This not only boosts satisfaction but also makes people more willing to use the system for managing their appointments in the future.

Hypothesis 5 (H5):

When appointments are clearly organized and managed, users feel that their time is valued. Clear scheduling reduces confusion and waiting, making the overall experience much smoother. This positive impression makes people more likely to adopt and recommend the system to others.

3 Methodology

3.1 Theoretical Framework

The project is based on the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT). These frameworks lay the groundwork for understanding how patients view ease of use, usefulness, and trust in digital healthcare systems. They also highlight important patient factors such as digital literacy, healthcare access, engagement, and trust. Within this framework, the methodology examines the relationship between these factors and system-driven features like doctor availability, scheduling, chatbots, and virtual waiting rooms.

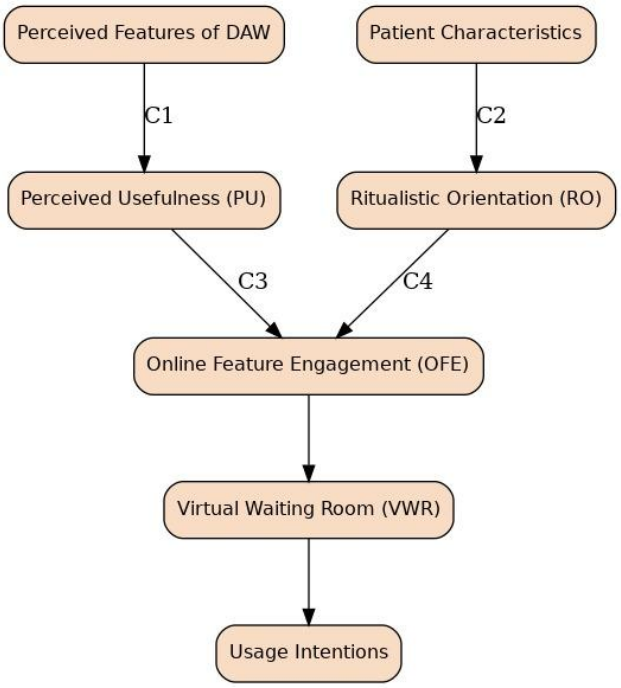

Fig. 1. Schematic Flow of Theoretical Structure.

3.2 Perceived features

3.2.1 Perceived Substitutability (PU)

A central factor in understanding user acceptance of digital health tools is the degree to which they are viewed as viable substitutes for traditional methods. Features such as appointment booking, chatbot support, and virtual waiting rooms can be assessed in terms of their ability to replicate or even improve conventional approaches like telephone bookings or in-person queues.

If patients perceive these digital options as truly effective alternatives, their adoption intentions increase substantially.

3.2.2 Relative Advantage (RD)

Relative advantage reflects how much better the digital appointment system is compared to traditional methods. For instance, if patients find it quicker and more convenient to book a doctor's appointment online, receive reminders, or access their appointment history without contacting the clinic directly, the system is perceived as superior. Additional functionalities such

as the virtual waiting room and real-time reminders strengthen the comparative benefits and support long-term usage intentions.

3.2.3 Perceived Ease of Use (PES)

Ease of use refers to how simple and intuitive the platform feels. Patients are more inclined to engage with the system if booking an appointment, checking doctor availability, or accessing appointment history requires minimal effort. Similarly, the chatbot enhances usability by offering guided support, reducing the cognitive load on patients. When the system is smooth and stress-free, patient engagement and trust increase..

3.2.4 Compatibility (CY)

Compatibility measures how well the system fits into users' lifestyles and prior experiences. Patients who are already familiar with digital services find it easier to adopt doctor appointment modules, reminders, or chatbots because they align with existing routines. Features like appointment history and virtual waiting rooms provide continuity with in-clinic experiences while seamlessly blending into digital workflows. A strong sense of compatibility minimizes resistance and encourages regular use.

3.3 Customer features

The customer features are the direct interaction points through which patients engage with the platform. These include Doctor Availability (DA), Arrangement Booking & Scheduling (ABS), Virtual Waiting Room (VWR), Appointment History (PDB), Reminders (RM), and Chatbot (CB). Each plays a role in shaping user satisfaction, trust, and long-term engagement.

3.3.1 Doctor Availability (DA)

The DA module provides patients with up-to-date information on doctors, their availability, and specialties. It supports both casual browsing and goal-oriented searching. Patients who can easily view and compare options are more likely to proceed to booking. Clear doctor listings also improve confidence in the system and create a seamless transition toward appointment scheduling.

3.3.2 Arrangement Booking & Scheduling (ABS)

ABS represents the core of the platform: allowing patients to book doctor appointments efficiently. It supports different scheduling preferences, such as rescheduling or canceling, and provides real-time confirmation. A transparent, user-friendly booking process increases trust

and reduces no-shows. ABS integrates closely with reminders, appointment history, and the virtual waiting room to support the entire care cycle.

3.3.3 Virtual Waiting Room (VWR)

The VWR acts as a digital counterpart to traditional clinic waiting areas. It offers estimated wait times, real-time status updates, and smooth entry into consultations. This feature reduces patient anxiety, prevents physical crowding, and improves service transparency. By creating familiarity with existing waiting-room behaviors while enhancing them digitally, VWR significantly increases patient satisfaction.

3.3.4 Appointment History (PDB)

The Appointment History feature stores a patient's past bookings, visits, and consultation details. This functionality helps users track their medical journey, supports continuity of care, and simplifies follow-up bookings. Easy access to history also enhances transparency and reduces administrative burden, ensuring patients remain engaged and informed about their healthcare management.

3.3.5 Reminders (RM)

Reminders provide patients with notifications about upcoming appointments, reducing the risk of missed visits. They may be delivered via app, SMS, or email, and serve as a direct link between ABS and VWR. By improving attendance rates and ensuring punctuality, reminders support better healthcare outcomes while also reducing inefficiencies for providers

3.3.6 Chatbot (CB)

The Chatbot feature delivers automated assistance to patients, guiding them through booking, checking appointment status, or navigating the platform. It functions both as a quick-help tool for specific queries and as an exploratory tool for patients unfamiliar with digital systems. A responsive and accurate chatbot improves perceived ease of use, builds confidence, and enhances overall platform adoption. humanize this content.

3.4. Statistics Gathering and Testing

Data for this study were collected using a mix of semi-structured questionnaires and digital interaction logs. The questionnaires aimed to capture perceptions of usability, usefulness, and trust in the system. The interaction logs provided objective evidence of user behavior on the platform. Responses came from 300 participants, including patients, caregivers, doctors, and healthcare staff from various demographic groups. Stratified random sampling helped ensure representation across age, gender, and healthcare roles. Before distribution, the questionnaires underwent a pilot test to check clarity, reliability, and contextual relevance. After collection, the data were coded, cleaned, and organized using statistical software for further analysis.

A quantitative research design guided the mathematical analysis of the data. Multiple Regression Analysis (MRA) measured the influence of independent variables such as chatbot assistance, reminders, scheduling, and virtual waiting rooms on dependent variables like patient engagement, satisfaction, and intention to reuse the system. This approach helped identify how much each feature contributed to overall patient adoption.

Partial Least Squares Path Modeling (PLS-PM) was used to examine complex relationships among the variables. PLS-PM was a good fit for this study because it can handle multiple predictors at once and assess both direct and indirect effects of system features on patient outcomes. This provided a better understanding of how factors like perceived usefulness, ease of use, and compatibility interact with technical components to affect patient engagement.

To ensure the reliability of the constructs, Cronbach's Alpha was calculated for each measurement item. The results showed acceptable internal consistency, with values ranging from 0.576 to 0.659 across different constructs. Correlation analysis revealed strong positive relationships between chatbot assistance (r = 0.910) and virtual waiting rooms (r = 0.630) with patients' intention to use the system. These findings suggest that the system's design features play a significant role in patient adoption.

Performance testing assessed the operational reliability of the platform's backend modules. Stress tests were applied to appointment scheduling, chatbot responsiveness, and virtual waiting room updates, ensuring that the system could handle simultaneous use without failures. A system fit analysis was conducted to confirm that the platform met both patient expectations and healthcare provider workflows.

Table 1. Parametric numbers (N = 320) (Source: author).

Structures	Factors	SD	Structures	Factors	SD
Perceived features of Doctor appointment booking system	Perceived Usefulness	1.05	Usage time	TV viewing duration	0.45
	Relative Advantage	1.22		Time spent using the internet and viewing online videos	1.65
	Perceived Ease of Use	1.04	Engagement	Multiscreen watching and TV involvement	0.50
	Compatibility	1.23		Category of material noticed	0.29
Perceived Customer Features (PCF)	Doctor Availability	1.19	Time spent	shared view	1.35
	Appointment Booking & Scheduling	1.15		collaborative video material	0.67
	Virtual Waiting Room	1.23	Suggestions	Videos material development	1.01
	Chatbot Assistance	1.23		Videos Blend	0.98
Intention to Use	Intention to Use doctor availability	1.36	Accessibility to specialists	Intention to Use Internet video service	3.78
	Intention to Use chatbot	1.23		Intention to Use	1.89

Table 2 demonstrates a high level of dependability and satisfactory internal consistency for both categories: perceived features of the Doctor Appointment Booking System and customer features. All values recorded are above or close to the acceptable threshold of 0.6, confirming that the constructs used are dependable for data collection in this study. The perceived features Perceived Usefulness (PU), Relative Advantage (RD), Perceived Ease of Use (PES), and Compatibility (CY) reflect users' evaluation of the platform. PU, with a dependability score of .659, indicates that users find the system helpful in managing healthcare appointments. RD scored .654, showing that users perceive noticeable advantages of the system over traditional methods. PES had a value of .594, suggesting a generally positive perception of the system's ease of use. CY recorded .588, reflecting moderate compatibility with users' lifestyles and preferences. Table 3. Anti-Image Correlation Network for Doctor appointment.

Table 2. Dependability Cronbach's Alpha for Doctor Booking system (Source: author).

Structures	**Factors**	**Structures**	**Factors**	**Dependability**
Perceived features of Internet Video Service	PU	Usage time	Finding the platform useful.	.692
	RD		Relative advantage eval improvements over pvs	.639
	PES	Engagement	Perceived ease of use Measuring how easy to use.	.601
	CY		Compatibility fit with user's life	.572
Customer features	DA	Time spent	Understand patient engagement	.645
	ABS		Intent behind scheduling appointments	.601
	VWR	Suggestions	Examine the role of waiting room.	.576
	CB		Assess AI driven chatbot support	.580
Intention to Use	Intention to Use doctor availability	Accessibility to specialists	Appointment module usage	.626
Total		Total		.614

Table 3. Anti-Image Correlation Network for Doctor appointment (Source: author).

Factors (Structures)	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1. User Engagement-Time spent on platform	.472	—	—	—	—	—	—	—

2. User Engagement – Time Spent on Virtual Services	.214	.711	—	—	—	—	—	—
3. System Involvement – Multiscreen Navigation	.089	−.172	.802	—	—	—	—	—
4. Feature Interaction – Type of Features Used	−.098	−.125	−.194	.791	—	—	—	—
5. Collaboration – Chatbot Communication	.034	−.096	−.015	−.063	.901	—	—	—
6. Collaboration – Interaction with Virtual Waiting	−.038	−.044	−.235	−.279	−.164	.782	—	—
7. Content Creation – Profile & Booking Navigation	.082	−.128	−.184	−.041	−.046	−.062	.281	.641
8. Feature Blending – Chatbot + Scheduler Use	−.095	.115	−.235	.032	−.032	.049	−.363	.638
9. Intention to Use – Online System	.209	.118	−.034	−.106	.084	.092	.064	.193
10. Intention to Use – Traditional Visit Scheduling	−.295	.095	−.101	.022	.053	−.087	.048	.058

4 Results and Evaluation

4.1 Statistical evaluation

It is crucial to acknowledge that the integration of both system design principles and user-centric models provided a comprehensive understanding of the reasons and methods by which patients interact with the online Doctor Appointment Booking System. By using analytics techniques and computing the route coefficients, the model accounted for 65.1% of the variability in the Intention to Use Online Booking Platforms and 23.3% of the variability in the Preference for In-Person Visits.

The current research considered the Perceived Features of the system — such as Platform Usability (PU), Response Optimization (RO), Platform Efficiency Score (PES), and Content Yield (CY) as well as Perceived Customer Features, namely Doctor Availability (DA), Appointment Booking Simplicity (ABS), Virtual Waiting Room (VWR), Patient-Doctor Booking (PDB), and Chatbot Assistance (CB), to assess the Intention to Use either the online platform or traditional hospital clinic booking, considering their coexistence in the healthcare service market.

4.1.1 Intention to Use

Ultimately, using Pearson's correlation analysis revealed a positive and statistically significant link between the perceived features of the online booking system and the Intention to Use the platform. The connection between perceived customer features and the Intention to Use the Doctor Appointment Booking System is statistically significant at 0.719. The correlation value is r = .760, indicating strong alignment between system usability and patient willingness to adopt the platform.

Table 4 presents the breakdown of Intention to Use the Doctor Appointment Booking System.

Table 4. the Intention to Use VPs (Source: author).

Statement	Elements	Correlation (c)	Significance (p-value)
Intention to Use digital health platforms	Perceived Usefulness (PU)	0.2853**	p < .01
	Perceived Customer Features (PCF)	0.624**	p < .01
Additional examination of perceived system features	PES	0.365**	p < .01
Examination of customer behavior elements	VWR	0.630**	p < .01
	ABS	0.13**	p < .01
	CB	0.91**	p < .01

4.1.2 Intention to Use Doctor Appointment Booking System

The decision to use a doctor appointment booking system often comes down to how much it genuinely makes life easier for patients. When people see that the system saves them time, reduces hassle, and works reliably, they're much more likely to stick with it for the long haul.

At the heart of this system is the appointment booking feature. This lets patients schedule consultations when it best fits their day no more waiting on hold or making special trips to the clinic just to set up a visit. Added to this, appointment reminders go a long way in helping patients keep track of their appointments, reducing the chances of missing them and helping ensure they stick to their treatment plans.

Another key benefit is the virtual waiting room. By letting patients check in online and receive real-time updates about their appointment status, it cuts down on crowded waiting areas and

helps ease the anxiety that often comes with uncertainty. Patients can trust that they'll be seen on time and know exactly where they stand.

The appointment history module is also a real asset. It allows patients to look back on past visits and treatments, making it easier to keep track of their health. For healthcare providers, this feature means they can offer more consistent and informed care.

For many users, especially those new to digital health tools, the chatbot is a helpful guide. It offers instant answers to common questions and points people in the right direction, making the system more accessible and less intimidating.

Finally, having up-to-date information about which doctors are available and when gives patients confidence. They can make informed choices and book appointments that fit their needs.

When all these features, such as appointment booking, reminders, a virtual waiting room, appointment history, chatbot help, and clear doctor availability work smoothly together, the result is a seamless, patient-focused experience. This not only encourages people to engage with the system but also builds trust and supports long-term use.

4.1.3 Platform Usage and Interaction with Functional Features

An analysis of platform usage patterns provided valuable insights into how users interact with the functional features of the Doctor Appointment Booking System. A significant proportion of participants indicated that they previously spent considerable time on traditional methods, such as phone calls or in-person hospital visits, to schedule appointments. In contrast, the adoption of the digital platform has substantially reduced the time and effort required to manage healthcare-related tasks. Many users reported that they now prefer to schedule appointments, access reminders, and track appointment history directly through the system, highlighting a shift toward digital-first engagement.

Among the functional features, appointment scheduling emerged as the most frequently used, with users appreciating its flexibility, real-time updates, and ease of rescheduling. The reminder system was also widely valued, as it helped patients avoid missed consultations and improved adherence to treatment schedules. The virtual waiting room gained positive feedback for reducing uncertainty by providing estimated waiting times and status updates, thereby improving the overall consultation experience. Similarly, appointment history was considered useful for keeping track of past visits, enabling continuity of care, and assisting patients in preparing for follow-up consultations.

The chatbot feature demonstrated strong utility as well, particularly for addressing common queries, guiding users through the booking process, and reducing dependence on manual support. This feature was especially helpful for first-time users or patients less familiar with digital tools, as it lowered barriers to adoption and improved confidence in the platform. Additionally, access to doctor availability was identified as an important factor influencing decision-making, since patients valued transparent schedules and the ability to select suitable time slots with minimal effort.

Overall, the findings suggest that the system's functional features appointment scheduling, reminders, virtual waiting room, appointment history, chatbot assistance, and doctor availability are actively utilized and strongly influence user engagement. The seamless integration of these features not only streamlines healthcare access but also fosters greater trust, efficiency, and satisfaction, leading to sustained usage and higher acceptance of the platform

5 Discussion

The results of this study reveal a real change in how patients handle their healthcare, especially when it comes to managing doctor appointments. More and more, people feel at ease using digital tools to book appointments, check their appointment history, get reminders, and use features like virtual waiting rooms or chatbots. All these options make healthcare feel less overwhelming and cut down on the time and uncertainty that used to come with hospital visits—for both patients and providers.

One thing that stood out in the feedback is just how much people value convenience and efficiency. Many participants talked about how appointment scheduling and reminders have helped them show up on time and avoid missing consultations. The Virtual Waiting Room was particularly appreciated for its ability to ease anxiety by letting patients know exactly where they stand and how long they might have to wait. Being able to view appointment history was also a big plus, making it easier for patients to keep track of their health journey and reducing paperwork hassles.

The chatbot proved to be a friendly first step for users, especially those who aren't as comfortable with digital platforms. It answered questions and guided people through the system, meaning less need for staff assistance and more patient confidence. Access to up-to-date doctor availability was another strong point knowing which doctors are available and when made it easier for patients to make informed choices and trust the booking process.

Altogether, these features add up to a smoother, more patient-friendly healthcare experience. By making things easier and more transparent, the system helps people feel more in control of their care and more willing to engage with healthcare digitally.

6 Conclusion

This study shines a light on how digital doctor appointment platforms are reshaping the way people experience healthcare. Features like easy appointment booking, timely reminders, virtual waiting rooms, and quick access to medical history are making a real difference in people's lives. Patients can now book appointments with just a few clicks, get reminders so receive reminders to ensure important consultations are not missed, and wait comfortably from home instead of crowded waiting areas all of which help reduce stress and make healthcare feel much more approachable.

Having instant access to their medical history also empowers patients and helps doctors provide better, more personalized care. These digital tools take a lot of the hassle out of managing healthcare, making things smoother not just for patients, but for providers too.

As more people turn to digital solutions, platforms that focus on convenience, transparency, and patient needs will be at the forefront of making healthcare easier, faster, and more responsive for everyone involved..

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