

New Method of Appointment Scheduling in Healthcare

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Abstract: *The aim of this project is to develop a comprehensive design for a cloud - based Patient Appointment Scheduling (PAS) tool. Existing scheduling methods, including Scheduling Matrix, Stream Scheduling, Wave Scheduling, Cluster Scheduling, and Double Booking, have not effectively addressed the persistent issue of patient no - shows. A critical factor contributing to this problem is the unavailability of preferred appointment time slots for patients. According to a recent study by the Medical Group Management Association (MGMA), even efficiently managed practices experience an average daily no - show and cancellation rate of 12%. This project seeks to mitigate this challenge by leveraging cloud technology to create a flexible, user - centric scheduling system. The proposed tool aims to enhance patient satisfaction and reduce no - show rates by optimizing appointment slot allocation and offering patients greater control over their scheduling preferences. Through detailed analysis and design, this project intends to provide a scalable and efficient solution to improve appointment adherence and overall healthcare service delivery.*

Keywords: Healthcare, Appointment Scheduling, No – Show

1. Introduction

Per National Academy of Engineering (NAE) and the Institute of Medicine (IOM) in the United States, healthcare sectors are facing more issues regarding cost, quality, and security. Whereas many other segments like industrial, logistics, warehousing, etc. are operating much more efficiently as those sectors are depending on systems - engineering tools. With the help of such systems in place, they could increase the revenues, decrease the costs and most importantly gain customer satisfaction. However, the healthcare sector is highly overlooked on such systems which could help the healthcare operate much more efficiently. Health care industry plays a vital role in the Global market. Global spending on health care sector is \$6.45 trillion and out of which the United States itself spends \$2.86 trillion. The United States account spends 17.2% of GDP on health care. By the year 2020, the United States is predicted to spend \$4.6 trillion on health care that is approximately 20% of United States GDP.¹ Healthcare facilities majorly owned and operated by private sectors and all the medical industry uses software systems to schedule, book, track the patient details and their appointments. The healthcare industry uses these appointments scheduling software applications to manage the demand of patient appointment requests. There is a significant deficiency in the appointment scheduling system as it is not working per patient preferences. Appointment scheduling software applications facing substantial challenges to incorporate the patient's preferred appointment timing. In some of the previous research on appointment scheduling systems by Gupta and Denton (2008) describe the issues related to appointment scheduling. They emphasized more on waiting for a model, i. e., direct and indirect waiting. The time, a patient spends waiting in the clinic on the appointment day from their entrance until their service is the "direct waiting time."² In research done by Nan Liu (2009) on appointment scheduling system with dynamic model, "we assumed that patients accept the first appointment date offered to them, which can be a reasonable assumption in

many cases."³ But in reality, all patients are not satisfied with appointment days which result into no - show or cancellations, and some of the patients to ask for another day's appointment. This study attempted to contribute to a more efficient and effective method of scheduling patient's appointments, where we can incorporate a set of rules into the appointment scheduling system. As in on which day, the patient has preferences since they do not only tell us on which day the next patient should be scheduled for but also provides provision for selecting other preferred days. This approach will reduce the no - show and cancellation problem to a great extent. And more patients can be served in a day; in turn, will generate more revenue. We can gain patients satisfaction and loyalty by providing the appointments as per their convenience. The system will even take care of fake appointments by filtering them based on authentication parameters. This approach will lead to a high turnaround of satisfied patients, a rise in revenue, gains patient's loyalty, etc.

2. Purpose

The purpose of this project is to create a detailed design of a cloud - based patient appointment scheduling tool. Despite many Patients Appointment Scheduling (PAS) methods in use like (Scheduling Matrix, Stream Scheduling, Wave Scheduling, Cluster Scheduling, Double Booking) the problem of no - show still exists, and one of the main reasons is that the patients are not getting the preferred appointment time slot. A recent MGMA study found that even well - run practices have a daily average of a 12% no - show and cancellation rate.

3. Limitations

This research of creating a detailed design of cloud - based patient appointment scheduling (PAS) tool has few limitations. Some of these constraints are, this study won't talk about whether this new method will apply to other countries. It does not even detail the technologies that will be

going to be used in this cloud - based PAS tool. Another major limitation may have to do with the data integration of all practitioners and the patients associated with them. Other limitations of this research are the factors in implementing in Government hospitals.

4. Methodology

This project will use qualitative research methodology by reviewing the published literature in articles, websites, journals on the challenges and the methods of Patient Appointment Scheduling (PAS) in healthcare. It will include a review of most existing methods of appointment scheduling in healthcare and their limitations. This project study will use an exploratory research design by conducting a thorough examination of the current problems with patient appointment scheduling methods and identify the primary cause of no - show and cancellation of appointments. It will also include a detailed design of a cloud - based PAS tool.

5. Literature Review

Strategies for Appointment Scheduling

In the Health Care Industry, while scheduling appointments, medical assistants should exhibit excellent interpersonal skills and reduce the amount of time a patient must wait to see the physician, this is the most important criterion. The medical associations should follow the following guidelines to encounter the above criteria:

- Do not disclose confidential health information to other patients.
- Instructions should be provided openly and should not appear rushed, and the medical assistant's voice tone should be friendly.
- The medical assistant should focus entirely on one patient at a time.
- A medical assistant plays a useful role in gathering all the essential information from the patient and seeing to its completeness and correctness.
- Assistants should always repeat the information to patients to avoid errors.
- Appointments should be scheduled for the proper amount of time based on the type of patient, i. e., new patients vs. established patients.
- The medical assistant should record the patient's information either in the computer appointment scheduling system or an appointment book.

Methods of Scheduling

Generally, in Health Care, the medical assistant uses two techniques to schedule appointments. Either they schedule the appointments manually, using an appointment book OR they use a computer to schedule an electronic appointment. Following are the methods:

Appointment Book Scheduling

In each clinic, they might use the same appointment book for scheduling appointments for each physician in practice, or they use the same appointment book for more than one physician of the same method. Usually, these appointment books are spiral bound, so that they can lie flat when opened. Appointment books are available in different formats like pages for a single day, pages that display a week or pages

which allow to schedule appointments for two or more physicians in a single day. These pages are further divided into 10 - 15 minutes' intervals between each appointment. A medical assistant must choose which appointment was scheduling book format he/she wants to use to meet the needs of that practice. When scheduling the appointments using a manual appointment book, medical assistant's use a pencil to write the scheduling details of the patients so that they can quickly erase to reschedule them or change any information. Further while preparing for a day's visit, the medical assistant either creates a typed or hand - printed list of patients known as a daily appointment schedule. This list is retained for permanent records.

Computer Scheduling

Nowadays using technology for scheduling appointments for patients is preferred. In many practices, they have started using computers for scheduling patient appointments, as it offers lots of advantages. A medical assistant can be more creative, as he/she can design different appointment intervals on the computer like 10, 15 or 20 minutes depending on the need for the practice. By using the computers, the medical assistants can quickly add, change or delete the appointment details, or even they can reschedule repeated appointments or set up a recall system. A recall system alarms the medical assistant which patients to be contacted for further appointments based on the scheduling entered in the computer system. These computer system facilities and entry screen to enter the same appointment scheduling information as an appointment book. It provides the provision to print out the daily appointment schedule of the patients to be seen for a day by the physicians.

Scheduling environments and decisions

The ensuing descriptions of the three commonly encountered healthcare scheduling environments are based on the authors' first - hand knowledge of the systems used by several health service providers. They do not reflect the specific practices of any one provider. Furthermore, they do not cover all possible variations found in practice. Instead, our goal is to paint a picture of the typical scheduling environment in each setting. We focus on three topics—access rules, encounter start times and approaches for handling differences between the scheduled and the realized supply/demand as the day unfolds. (Note that sometimes appointment scheduling is understood to imply only the task of setting encounter start times.) Access rules help sort patients into different priority classes, specify access targets and the amount of reserved capacity for each class, and guide managers' response to the variation between realized and scheduled demand and supply. Encounter start times specify the date and time when service providers and patients are expected to be ready for the examination or procedure. Differences between scheduled and actual demand/supply are common. They can arise because of more prolonged than expected service times, provider/patient tardiness, late cancellations and no - shows, and unanticipated urgent/emergency demand. Hereafter, we refer to the latter decisions as daily scheduling decisions. Equipment/staff capacity choices and staff scheduling also affect appointment scheduling; they are not considered in this paper.

Primary care appointments scheduling

Historically, primary care practices were the quintessential cottage industry within the system of delivering health care. Physician - owned and - managed clinics were typically served by a single doctor or a small group of doctors, who took care of the medical needs of families from the cradle to the grave. Appointment systems tended to be manual and ad hoc, and physicians often worked variable hours to provide needed service to urgent requests. In recent years, clinics have grown larger. Often, they are a part of an even larger health care delivery system (or network) comprising many primary care and specialty clinics and hospitals. Modern clinics also have on - site lab facilities and X - ray machines for carrying out routine diagnostic tests. When faced with a medical problem, patients often contact their Primary Care Physicians (PCP) first, with the result that PCPs are sometimes called the gatekeepers of the health care delivery system. In most cases, patients call in advance to book an appointment; however, some do walk in. Some clinics have on - site appointment schedulers. Increasingly, however, appointment booking operations are centralized at a remote call center, which serves many clinics belonging to a healthcare network. Physicians divide their available clinic time into appointment slots, which are usually between 15 to 30 minutes long. In addition, providers determine the number of standard slots needed for each category of appointment request. Certain types of appointments, e. g., physical exams, require multiple slots. Other types, e. g., routine follow - up visits, require a single slot. Providers choose to start and end times of their work schedule for each day over a pre - specified period (say 4 weeks) several weeks in advance of that time. They also provide schedules with restrictions on how available slots may be assigned to incoming requests for appointments. For example, certain appointment slots are reserved each day for physical exams, which makes it easy for schedulers to find contiguous open slots needed for such appointments. This practice also helps physicians plan their day in advance. Access rules in the primary care environment reserve certain slots exclusively for certain types of patients. Patient types could depend on medical urgency, type of service requested and on whether the patient belongs to the physician's panel. For each physician, his/her panel consists of all those patients who have designated him/her as their PCP. Matching patients with their PCPs is important for continuity (quality) of care and for clinic efficiency because otherwise physicians end up spending more time reading medical histories of unfamiliar patients. A recent innovation that has been adopted by many primary care clinics is the Advanced or Open Access system, credited to Murray and Tantau (1999, 2000). In this approach, physicians attempt to accommodate patients' requests for appointments on the day they call. (This is not to be confused with walk - ins who do not call - in advance. We discuss walk - ins at a later point in this section.) Future appointments at a time that is more convenient for the patient are also permitted. Service providers vary available capacity to meet each day's demand. The ability of a patient to book an appointment on the day (s) he calls is no longer a function of his/her medical condition. In contrast, clinics that do not offer Advanced Access often employ a triage nurse to assess the urgency of medical need of a caller who requests an appointment without delay. Only those callers whose need is deemed urgent are offered one of several slots reserved each day for urgent requests. The impetus for adopting Advanced Access comes from the desire to make clinic practices more patient -

focused, to accommodate faster access for patients with urgent needs and to gain competitive advantage. This approach also eliminates the need for a triage nurse. However, the implementation of Advanced Access systems remains a challenge because of a variety of reasons. First, even when providers work hard to absorb variations in daily demand, their ability to do so is limited. Therefore, it may not be possible to accommodate all appointment requests on the day they originate. This leads to demand spillover to a future day, limiting the clinic's ability to meet that future day's demand. Second, the true demand for same - day service is not captured by the appointments data because it is difficult to tell whether a patient preferred to book an appointment on a future date, or (s) he did so because a same - day appointment was not available. This makes it difficult for clinic directors to determine approximately how much capacity should be available at the start of each day for that day's demand. Third, in many clinics, different physicians' panel compositions and sizes are significantly different, with the result that some physicians have fewer available slots to accommodate same - day demand. In addition to deciding how to schedule appointment requests from patients who call in advance, primary care clinics also need to decide how to respond to walk - ins, and any unplanned shortfall in capacity (due to provider illness or emergency) while minimizing their impact on the direct waiting time of patients with scheduled appointments. We call such decisions by clinic managers daily scheduling decisions. Therefore, many are experimenting with alternative ways to accommodate daily scheduling variation, such as pooling provider appointment slots for urgent care, using nurse practitioners and doctors' assistants, and forming provider teams. With a provider team in place, when an appointment with a patient's PCP is not available, (s) he is offered an appointment with a member of the care team who is somewhat familiar with the patient's medical history.

Specialty clinic appointments scheduling

Specialty care clinics are designed to deliver health services that are focused on specific, often complex, diagnoses and treatments. In some cases, multiple medical specialties may be integrated into a group practice which may have several departments, each specializing in a different branch of medicine. Rules governing access to specialists can vary by the medical specialty, as well as by the health network. This means that patients can call to book an appointment without the need for a referral first. In fact, it is not uncommon to find a shared call center, which serves all primary care and open access specialty clinics in a healthcare network. In that case, the referring physician is often the patient's PCP and his/her clinical assistant books an appointment for the patient. In many instances, a referral is required only for the first appointment, and the patient can directly schedule all subsequent appointments. Unlike a primary care environment where most services can be performed within a fixed - length appointment slot, specialists' appointment lengths can be highly variable and diagnosis dependent. Thus, specialty clinics face the difficult task of simultaneously guaranteeing quick access for high - priority cases and realizing high utilization of the specialist's time. Access rules help clinics determine how much capacity to reserve for each type (or length) of appointment and future callers with more urgent needs. A crossflow occurs when a patient discovers during an

appointment with a specialist that (s) he needs an appointment with a different specialist to complete his/her diagnosis/treatment. Daily scheduling concerns were taking care of deviations from planned clinic time and booked appointments, both of which are common in specialty services. For example, when outpatient clinics are attached to hospitals, specialists may serve as stand - by consultants and providers of emergency care. In such cases, health care providers may collaborate to pool resources, for instance, by having a rotating specialist - on - call schedule.

Proposed Solution

This solution will be an online web - based scheduling software application that allows individual patients to conveniently and securely book their appointments by choosing their convenient time. Significant features of this application will be:

- Doctors can configure their availability to the outer world. Like: Doctor “A” can configure her availability from morning 8 a. m. to noon and afternoon 2 p. m. to 5 p. m. and can even set intervals of each appointment like 30 mins.
- Patients must register to PASS by providing necessary information related to their insurance and address. Once recorded they can login into PASS and search nearby doctors who are using PASS and by selecting any doctor, a patient can be able to see that doctor chosen's availability like what all time slots on what all dates the chosen doctor is available.
- The receptionist will also be going to use this PASS to confirm the appointments with the patients and gather relevant details like their insurance details and the purpose of the appointment.

Audience of this document

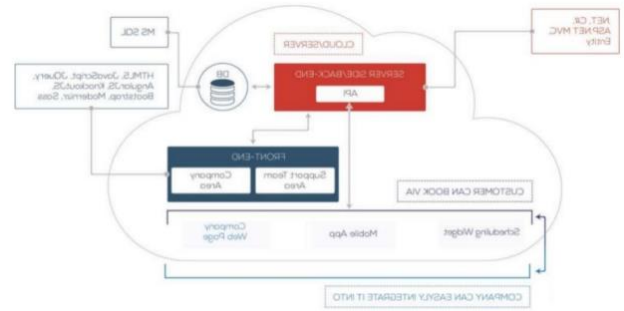
This document will talk about the PASS concerning its functionality, features, high - level designs like Data Flow Diagram, Class Diagram, Use Case Diagram, Test Plans, etc. . . . The audience of this document will be majorly Product Owner, Business Analyst, Technical Architect, User Interface Designers, DBA, Developers, etc....



Architecture and Technologies

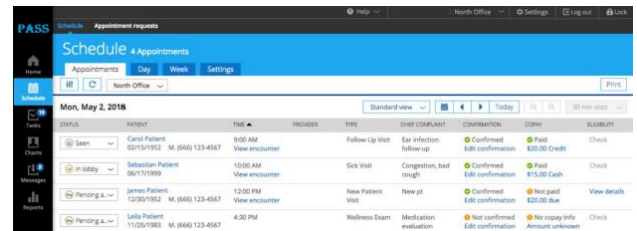
Recommended Architecture would be Cloud - Based Hosting of PASS will help to integrate with other third - party

applications and can be accessed anywhere everywhere. Recommended Technologies would be Microsoft. Net with C#, ASP. NET with MVC, Entity Framework, Microsoft SQL Server, HTML5, JavaScript, jQuery, Angular JS, Bootstrap, Knockout JS, and Sass.

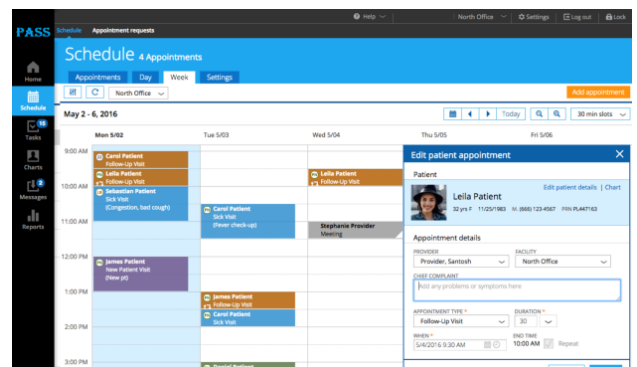


Prototype:

These few below prototypes are just my recommendation and can be used by the User Interface developers.



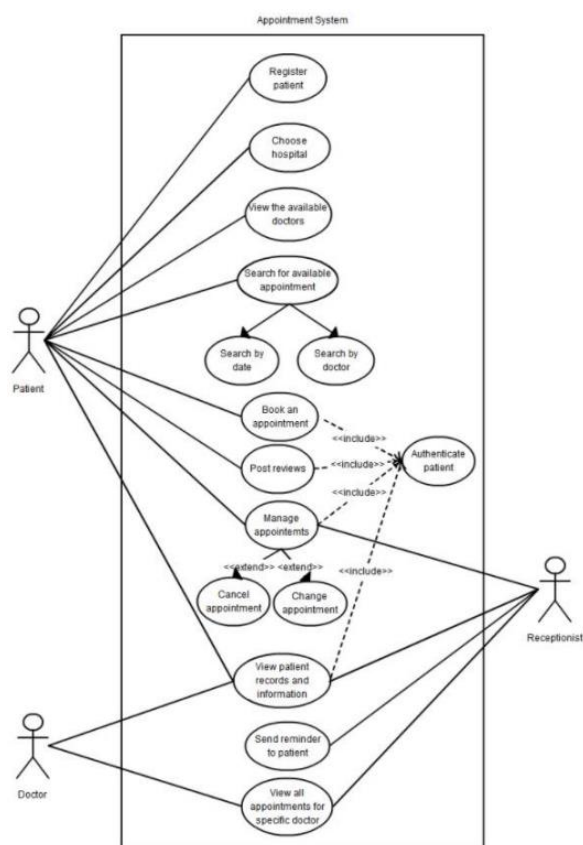
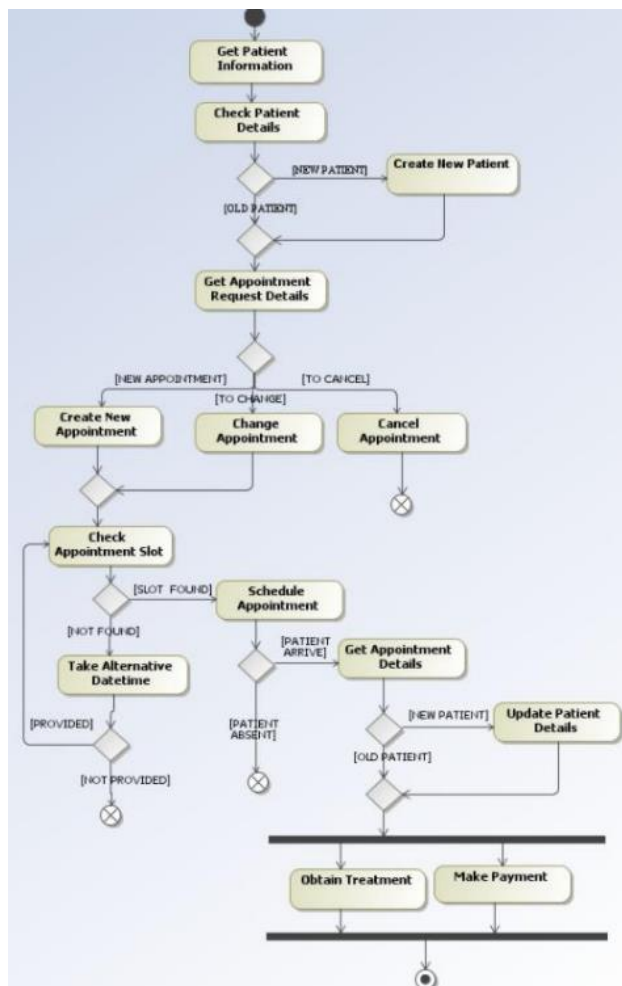
List of Scheduled Appointments



Scheduling and managing appointments from Scheduler module

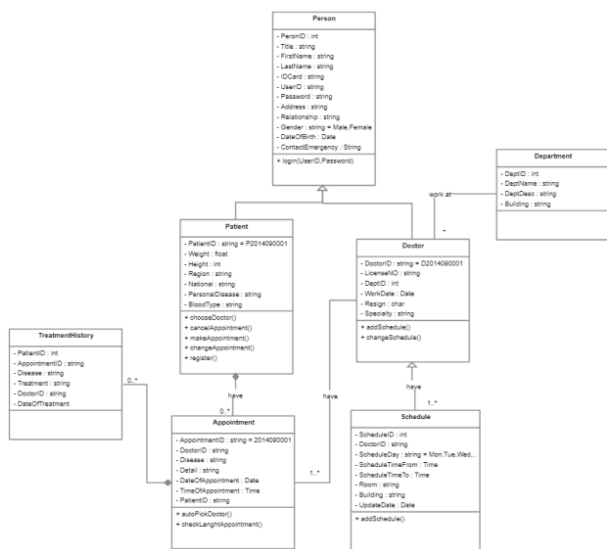
Data Flow Diagram:

The below data flow diagram will broadly display how the data will flow in the PASS between Patient, Doctor, and Receptionist.



Class Diagram:

Below Class Diagram will be used by the technical team for designing the modules and mapping the PASS entities with the database entities.



Use Case Diagram:

Use Case Diagram will be helpful to the business analyst or product owner to write up the user stories if they want to adopt Agile Methodology to design this PASS.

6. Conclusion

This project focused on solving the problem of patient no - shows in healthcare by creating a cloud - based Patient Appointment Scheduling (PAS) tool. Traditional methods like Scheduling Matrix, Stream Scheduling, Wave Scheduling, Cluster Scheduling, and Double Booking haven't been effective enough because they don't always offer patients their preferred appointment times. This lack of flexibility leads to a high rate of no - shows. According to a study by the Medical Group Management Association (MGMA), even the best - managed practices have a daily no - show and cancellation rate of 12%. This shows there's a real need for a better scheduling system. Our project uses cloud technology to create a flexible and patient - friendly scheduling tool that makes it easier to find and book preferred appointment times. The PAS tool aims to improve patient satisfaction by offering more convenient appointment options, which should help reduce no - shows. This tool is designed to help healthcare providers manage their schedules more efficiently and meet patient needs better.

In summary, the cloud - based PAS tool offers a major improvement in dealing with patient appointment scheduling problems. By making it easier for patients to get the appointment times they want, it reduces no - shows and boosts patient satisfaction. This project presents a scalable and effective solution to enhance healthcare service delivery, making operations smoother for medical practices and leading to better health outcomes for patients.

References

- [1] Gupta, D., B. Denton.2008. Appointment scheduling in health care: Challenges and opportunities. IIE Transactions 40 (9) 800–819. Nan Liu.2009. Appointment scheduling in healthcare