Patient Opportunities to Self-Schedule in a Large Multisite, Multispecialty Medical Practice: Program Description and Uptake of 7 Unique Processes for Patients to Successfully Self-Schedule (and Reschedule) Their Medical Appointments

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Abstract

Introduction: Patient self-scheduling of medical appointments is becoming more common in many medical institutions. However, the complexity of scheduling multiple specialties, following scheduling guidelines, and managing appointment access requires a variety of processes for a diverse inventory of self-schedulable appointment types.

Methods: From 7 unique patient self-scheduling methods, we captured counts of successfully self-scheduled and completed appointments. A process map was created to show the paths of 5 different primary self-scheduling processes (new appointment self-scheduling) and 2 secondary self-scheduling processes (existing appointment self-rescheduling).

Results: There were 7 unique processes that led to 733,651 successfully self-scheduled completed visits from January 1 to December 31, 2023 at a multisite, multispecialty clinic. The self-scheduling processes consisted of the following: (1) Ticket offer (appointment "ticket" offers for specific visits generated by a provider order or system rules), the software "ticket" sent to the patient permits "admission" to self-schedule calendar templates (341,591 uses, 46.6%); (2) direct self-scheduled visit for prequalified visit types (203,593 uses, 27.6%); (3) self-reschedule option (patient option to reschedule existing appointment, 79,706 uses, 10.9%); (4) new patient self-scheduled visit via clinic website (does not require portal access, 54,367 uses, 7.4%). (5) automated waitlist self-rescheduled visit (38,649 uses, 5.3%); (6) automated waitlist self-scheduled visit of previously unscheduled visit (10,939 uses, 1.5%); and (7) self-triage self-scheduled visit (4806 uses, 0.7%).

Conclusion: The processes for self-scheduling are expanding. Our multispecialty clinic has implemented 7 different processes to help patients successfully self-schedule medical appointments. Some of the processes occur before initial scheduling (such as self-triage), and some are implemented after successful scheduling has already occurred (self-rescheduling option and self-rescheduling aided by an automated waitlist). Continued research is needed to look for measures of success beyond the ability to complete a self-scheduled visit, including the accuracy of the booking (right provider, location, and length of visit).

Keywords

self-schedule, access to care, practice management, visit scheduling, appointment waitlist, appointment scheduling

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Introduction

In-person and virtual medical visits are now being self-scheduled in many different ways and locations, including visits at nonclinical sites. For example, visits for routine immunizations in the United States are now being self-scheduled at local pharmacies such as Walgreens and CVS.[1,2] In-person lab test visits are being self-scheduled in collection locations across the United States, directed by large commercial labs that analyze blood, urine, and other specimens.[3,4]

Self-scheduling medical visits also take place through online services such as Zocdoc and Lybrate.[5–7] These companies show patients appointment options with local providers who have linked their schedules to these services. These self-scheduling platforms may improve the ability of providers to optimally fill their schedules and assist patients seeking earlier appointments with nearby providers. For example, one study evaluated Zocdoc options for primary care appointments across 20 cities in the United States and found a mean of 20 available appointments within 3 days for the 10 closest physicians at a mean distance of 8.9 miles from the standardized patient location (100 Main St) used in this study.[8]

Self-scheduling for established patients within medical practices is also expanding nationally and internationally. In 2006, Lowes described a Texas, USA, medical practice and a New York City, USA, medical practice where 15% to 50% of daily appointments were self-scheduled.[9] Between 2019 and 2021, the Johns Hopkins community practice in the United States saw self-scheduled appointments increase from 4% to 15% of kept appointments.[10] Zhang et al.[11] describe implementation of self-scheduling for a primary care practice in Australia in 2011 that was used by 15% of the of the interviewed patients. In England, the National Health Service (NHS) is facilitating and promoting online booking of GP services as a way to "increased patient satisfaction," "increased operational efficiencies for practices," and "reduction of DNAs for practices" (DNAs—people who do not attend or no-shows).[12]

Self-scheduling has also been used successfully for specific appointment types in multispecialty groups. Mayo Clinic and Johns Hopkins have used automated systems to alert patients when screening mammograms are due and allow self-scheduling of those visits.[13,14] Mayo Clinic also developed self-scheduling for routine well-child visits[15] and use self-triage and self-scheduling for online evaluation of ear and hearing concerns as well as depression.[16–18] Lab tests have been another successful use of self-scheduling in multispecialty practices. The University of California San Francisco and Mayo Clinic used self-scheduling to handle the surge of COVID-19 testing needed during the COVID-19 pandemic and showed significant efficiencies attained with self-scheduled COVID tests.[19,20]

A recent Mayo Clinic study found that large numbers of unique visit types were a major challenge for self-scheduling.[21] Several different self-scheduling processes have been developed and used to meet the challenges associated with self-scheduling,[21] but to our knowledge, there has been no published description of these self-scheduling processes as part of an integrated appointment scheduling process flow. Our aim in this study is to describe how one multispecialty medical practice has developed and implemented 7 different processes for patients to self-schedule medical visits. We show where these 7 different self-scheduling processes are integrated into the overall appointment scheduling process flow, and we also describe demographics and uptake of self-scheduling services over a 1-year period.

Methods

Setting

Mayo Clinic is a multispecialty medical practice with multiple locations in the United States and internationally. Nearly 1.3 million (M) patients come yearly to Mayo Clinic campuses. Mayo Clinic has primary care sites in locations of lower population density as well as in urban areas where specialty services are nearby. Mayo Clinic has a website, MayoClinic.org, that is a site for information for general health, and also has information for patients who may be interested in making appointments with Mayo Clinic providers. Both new and returning patients can start the appointment scheduling process through MayoClinic.org. Established patients also have access to create an online portal account to access messaging, test results, and appointment information and to self-schedule appointments.

Self-Scheduling Process Development

Epic® is the electronic health record (EHR) used by Mayo Clinic since 2018. Epic has software and information technology (IT) support for managing and developing processes for patient appointment scheduling. The Epic EHR has self-scheduling tools that are made available to patients through Mayo Clinic's online patient portal, the Mayo Clinic patient mobile application, and the MayoClinic.org website. Over the course of several years, Mayo Clinic has used 7 distinct self-scheduling processes to help patients self-schedule appointments.

Initially, self-scheduling was used for very specific use cases such as the periodic well-child visit and screening mammography. These 2 self-scheduling processes both have well-established national guidelines for eligible patient characteristics and scheduling intervals.[14,15,22,23] Later, self-scheduling was used to successfully handle the surge of visit demands associated with COVID-19 testing and vaccination.[20,24]

Self-scheduling for COVID-19 testing led to development of a process that would direct patients to seek emergency care if their symptoms suggested they were at high risk. The experience with COVID-19 symptom self-triage prior to self-scheduling also led to further development of self-triage prior to self-scheduling. Self-triage associated with self-scheduling has continued to expand beyond COVID-19 testing and is used to help patients self-schedule visits for acute and worsening symptoms. One of the Mayo Clinic processes for self-

scheduling uses self-triage and is included as 1 of the 7 processes in this study.

Additional processes for self-scheduling evolved and were implemented as a response to patient and practice needs. The self-scheduling processes we describe and quantify are part of an ongoing development to expand and improve visit scheduling at a multispecialty practice.

Self-Scheduling Process Categories

Figure 1 shows a high-level flow diagram of the 7 actively used self-scheduling processes at Mayo Clinic. Figure 1 shows where self-scheduling can occur at different points in the scheduling process. Appointments can be self-scheduled from the start of the appointment process or later, even after the appointment has already been scheduled. When self-scheduling is the initial scheduling event, we term this primary self-scheduling. When an appointment is already scheduled and then

rescheduled through self-scheduling, we refer to this as secondary self-scheduling or self-rescheduling.

Figure 1 shows 5 different primary self-scheduling processes where the initial appointment has been self-scheduled or a self-scheduled process is initiated. These are represented by the 5 processes in the rectangular (red) boxes in the middle left of the Figure 1 flow diagram. These 5 processes vary in terms of the clinical input needed from the practice to allow self-scheduling for different visit types. The rhomboid shapes in Figure 1 in the primary self-scheduling flow on the left show some of the input features that differentiate the 5 processes currently in use for primary self-scheduling.

Four of the 5 primary self-scheduling processes require significant clinical input prior to self-scheduling (as indicated in the rhomboid shapes above the Figure 1 primary self-scheduling processes). One of the primary self-scheduling processes, direct self-scheduled, involves very little clinical input and is initiated by the patient. From the patient perspective,
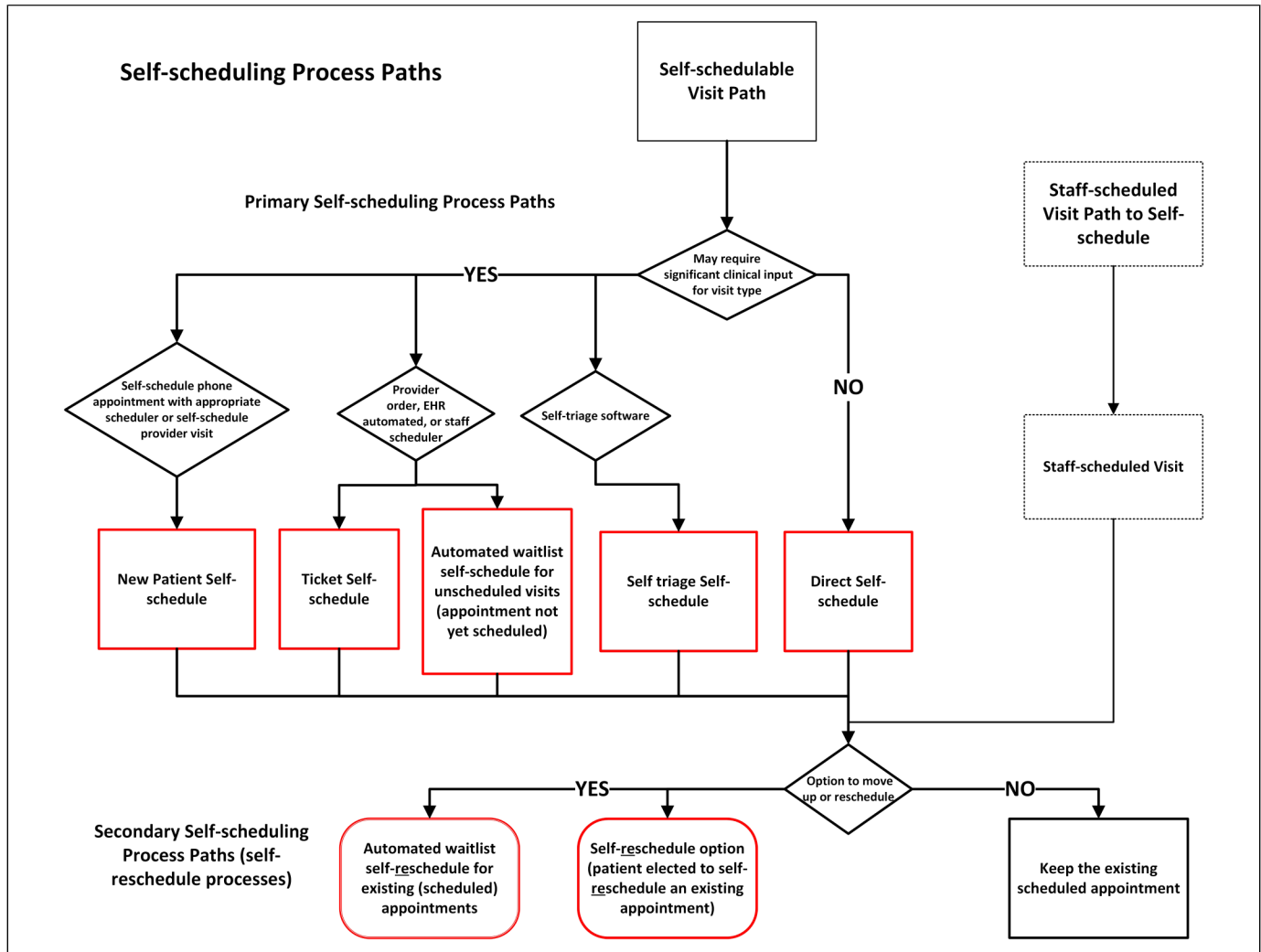

Figure 1. Self-scheduling process flow. Sharp-edged (red) rectangles are self-scheduling processes that are for initially scheduling a visit (primary self-scheduling). The smooth-cornered (red) rectangles are self-scheduling processes for existing scheduled appointments (secondary self-scheduling, or self-rescheduling).

this direct process involves little more than a few clicks in the patient portal to self-schedule. This is shown in Figure 2 which shows an actual patient portal screenshot of a menu of appointments that can be directly self-scheduled, for example, immunizations, primary care visits, express care visits, and eye exams. Further on, all the self-scheduling processes are described in more detail.

Two current self-scheduling processes can be applied to already existing (scheduled) appointments. Since the primary event of scheduling the appointment has already occurred we refer to these processes as secondary self-scheduling, or self-rescheduling. These are shown as the smooth-cornered rectangles on Figure 1. The self-reschedule process can reschedule existing scheduled appointments that may have been initially created either as a self-scheduled appointment or a staff-scheduled appointment. The right side of Figure 1 flow diagram shows how the secondary self-scheduling path (also referred to as self-rescheduling) can also flow from existing staff-scheduled appointments.

The self-reschedule process is initiated by a patient who wants to reschedule an existing appointment for an earlier or later time. The automated waitlist self-reschedule is a computer algorithm process that sends offers to the patient to reschedule the appointment to an earlier date or time. Automated waitlist

Figure 2. Patient portal view of the page for direct self-scheduling of appointments.

self-rescheduling occurs when the patient accepts a sooner appointment; the original existing appointment is kept if the patient declines or does not accept. Because self-rescheduling starts from an existing appointment, elective self-rescheduling and automated waitlist self-rescheduling can be accomplished without staff schedulers. For the automated waitlist rescheduling process, open times and dates are sent to the patient, allowing them to reschedule or decline and keep the previously scheduled visit. The waitlist rescheduling offer is time limited which, if not accepted before the offer expires, allows the open appointment to be used by someone else. Thus, the open appointment can recycle on the automated waitlist as an appointment offer to someone else, or a staff scheduler can use it to manually schedule that open time with another patient. Since all the necessary clinical input was obtained at the initial scheduling, no further clinical input is needed. It should be noted that patients can seek help from staff schedulers at any time via telephone or by portal (Figure 2 option "Request an Appointment … if other scheduling options do not fit your needs").

Regardless of how the self-rescheduling is initiated, the result is that the patient is presented with a way to self-reschedule. Those receiving scheduling offers from the automated waitlist processes are presented specific available dates and times determined by the waitlist algorithm and described in more detail later. For those self-scheduling with the other processes, a scheduling template is presented such as seen in Figure 3. With the self-reschedule option process, patients can also reschedule their previously scheduled appointment 24/7. Below, we describe in more detail the 7 self-scheduling processes currently in use.

Ticket Self-Scheduling. Virtual "tickets" are self-scheduling offers that are generated from a provider order, scheduling staff, or an automated process controlled by the practice. As with physical tickets, the virtual "ticket" allows admission into the self-scheduling process, just as tickets allow admission to sports events and concerts.

Providers generate the self-scheduling offer by putting through an order for a visit, test, procedure, or some other schedulable event that can be ordered. The provider does not need to know how the visit is scheduled. Rules in the scheduling system determine whether the visit is self-schedulable. The notification to the patient of the virtual "ticket" can be sent automatically by rules or it can be manually triggered by scheduling staff. On the patient portal, the "ticket" allows the patient to self-schedule by creating a link to a self-scheduling template that the patient uses to pick the time and date of the ordered/approved appointment. The self-scheduling template is of the same format as used for direct scheduling (Figure 3). The "ticket" offer is also viewable by staff schedulers, so the visit can be staff-scheduled without further provider intervention if the patient elects not to self-schedule. It should be noted that the order for a visit has an expiration date. If the patient does not accept the "ticket" to self-schedule an appointment, the opportunity to schedule will be removed when the clinical order expires.

Ticket scheduling also can be generated automatically with a software rules engine. Mayo Clinic has used software rules based on clinical guidelines to generate "ticket" visit offers for patients who are due for screening mammograms, laboratory blood draws, lung cancer screening, and Medicare annual wellness visits.

A critical element of ticket scheduling is the need for practice control over this process. These are for visits that have guardrails controlled by the practice. The "ticket" assures that the practice has vetted the appointment request in several domains. There are assurances that the appointment is structured correctly via automated software, or by scheduling staff using defined protocols, or from the provider creating the order for the appointment. For example, before automated "tickets" are sent to patients to self-schedule screening mammograms, there are checks to ensure that frequency rules for mammograms are not violated (ie, scheduling needs to be greater than 1 year after previous screening mammogram was performed). Also, if a patient messages the provider about an appointment, the provider may reroute to the scheduling team. The scheduling team can then run the request though a decision tree and manually send a ticket to the patient to self-schedule. This is an example of a non-ordered, but approved, visit to schedule. Also, tickets to schedule procedures and laboratory tests are needed to assure that the scheduled lab or procedure meets chain of responsibility rules for abnormal results. Extra practice rules surrounding tickets help distinguish them from direct scheduling, where patients are freer to pick and choose appointments with fewer practice rules limiting their use.

Direct Self-Scheduling for Established Patients. For established patients who are seeking follow-up with primary care or specialist providers or who want to be scheduled for an uncomplicated visit, direct self-scheduling allows them to directly access a clinical scheduling calendar for designated visit types. A direct self-scheduling menu from the online patient portal is shown in Figure 2. Clicking on any of the self-scheduling menu items leads to a self-scheduling template as shown in Figure 3 which was a self-scheduling template for a COVID-19 vaccination. Thus, just a few clicks allow patients to directly self-schedule for select visit types.

Visit types for direct scheduling are limited to those that do not require staff scheduler or provider input and do not involve complex software algorithms to restrict scheduling for these visit types. The menu items shown in Figure 2 are not static and vary according to available data in the EHR, including patient demographics, previous visit history, status of preventive care screening, and other data in the EHR. Figure 2 is a screenshot from a 70-year-old male patient during January when influenza vaccination was active. Clickable menu items to self-schedule would be different for someone younger, female (example in Supplemental Material), and during months when seasonal vaccines like influenza are unavailable.

As seen in Figure 2, vaccination visit types can be major menu items for direct self-scheduled visits. Another direct self-scheduled visit type seen in Figure 2 is a primary care visit with the patient's established provider. These direct scheduled visits are linked first with the patient's established provider schedule
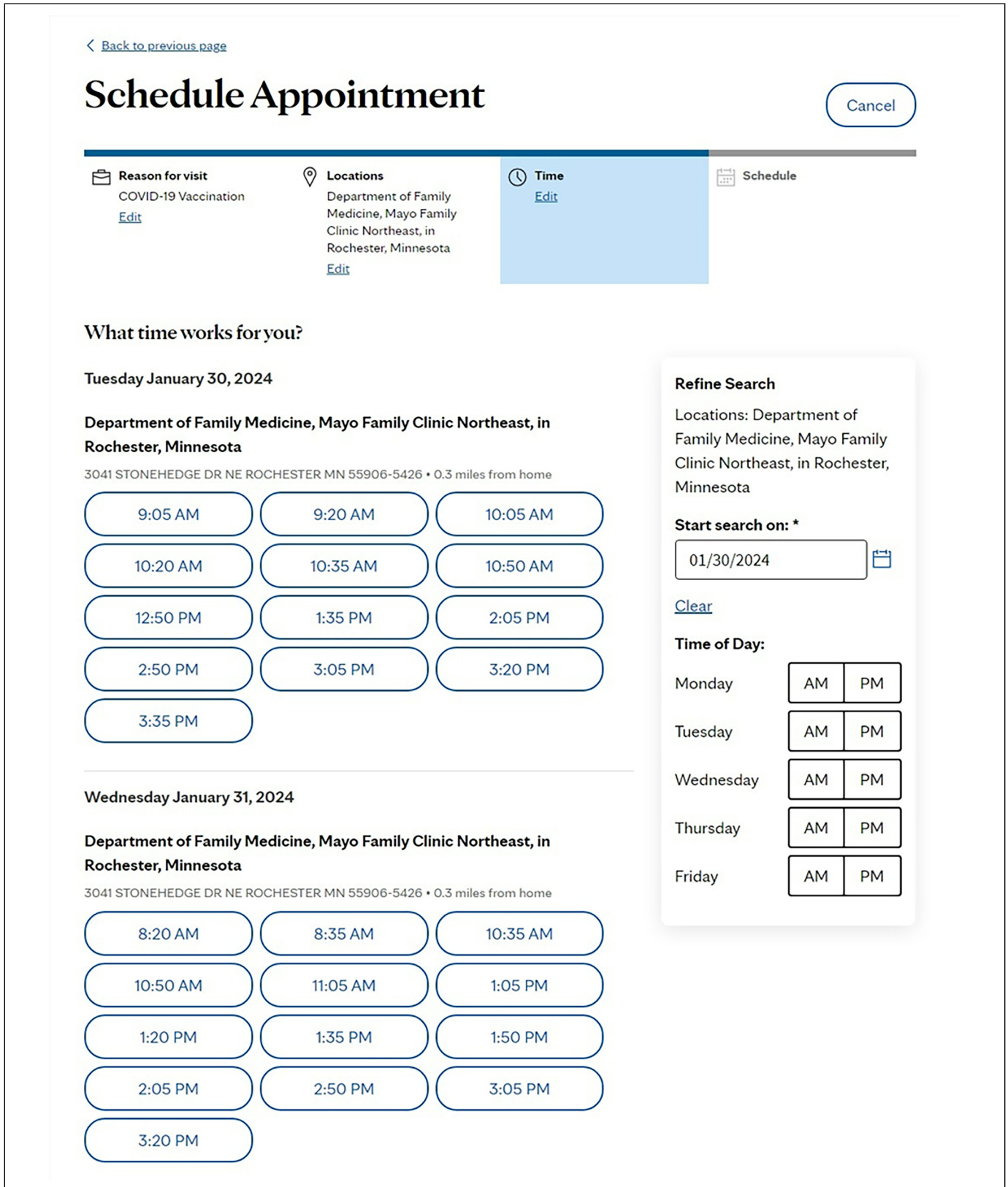
Figure 3. Patient portal screenshot of a scheduling template for a COVID-19 vaccination.

for appointment openings. However, if no appointments with the established primary care provider are available to suit the patient, then the patient can click on a button "Add provider's team" with the caption: "Want to see more times?– Include other members of this provider's team to increase the number of available times." This patient-centric scheduling option allows patients to see appointment times of other providers on the same care team, allowing a potentially sooner visit while maintaining healthcare continuity.

Visits that may not need pre-visit testing are also candidates for direct self-scheduling. Eye exams (Figure 2) and some dermatology visits are currently being successfully self-scheduled using this direct self-scheduling process type.[24]

New Patient Self-Scheduling via Healthcare Institution Website.
New patient self-scheduling is a process that allows a wider participation of individuals with healthcare needs to self-schedule. Prior to this process, new patients have had to go through patient registration processes to schedule an appointment. After that, patients wanting online access to self-scheduling would need to set up a patient portal account. Now, the new patient self-scheduling process allows patients to self-schedule some visit types online, without first going through the process of setting up a Mayo Clinic patient portal account.

New patients, particularly those who are seeking specialty care for a new or recent diagnosis, may have heard about Mayo Clinic and sought out further information on the Mayo Clinic website, MayoClinic.org. New patient self-scheduling was designed for patients who visit the MayoClinic.org website but are not registered Mayo Clinic patients. The website has information for general health, specific symptoms, and information on both common and rare diseases. Up until recently, individuals who were not registered Mayo patients could only get appointment contact information from the MayoClinic.org website.

From the MayoClinic.org website, patients can fill out personal and administrative information needed to self-schedule an appointment. The goal is to obtain sufficient information to get an appointment of the correct visit type to meet the patients' needs. This is no small task as Mayo Clinic has several hundred new patient visit types.[21] In many cases, more information is needed to ensure the patient is matched to the right visit type. These patients are offered the ability to self-schedule a telephone call with a new patient appointment specialist who is versed in the pre-visit information needed for the specific specialty or visit type requested. These specialty appointment schedulers can help patients gather the information needed to schedule an appropriate specialty or sub-specialty visit for the patients' needs and expectations. Under some conditions (determined by software decision trees on the website), new patients can directly schedule an appointment on a specialist calendar from the MayoClinic.org website.

Patient Self-Scheduling Associated With Self-Triage.
Patients experiencing a symptom or concern often seek advice on what they should do. Unfortunately, symptoms do not always occur during regular outpatient clinic hours. In 1 US national survey, 1 in 5 people who attempted after-hours contact with their primary care provider reported it was very difficult or somewhat difficult to reach a clinician.[25] For some, a triage nurse call may be an option. Others may go to the local emergency department (ED). Some just want to schedule a visit with a provider.

Online patient self-triage tools, also known as symptom checkers, can help patients with the urgency of their concern, recommending an ED visit for conditions that may require urgent care, or home care if the symptom does not require immediate care.[16–18,26–35] If the self-triage tool deems appropriate, patients can be directed to self-schedule an appointment. The self-triage tool is a computerized program which prompts a series of questions to patients, adjusts questions based on previous answers, and provides patients with a next step, including recommending ED care, call nurse triage, a self-scheduled appointment, or home care. This method of combining self-triage with self-scheduling has been successfully used with COVID-19 testing and ear and hearing concerns.[17–20,36]

Automated Waitlist Self-Schedule for Authorized but Not-Yet-Scheduled Appointments.
This waitlist process is designed specifically for visits that are authorized to be scheduled but the template to schedule is full or cannot accommodate the patient's schedule. When there are no available appointments to offer, having an automated waitlist option can help assure the patient that they will be alerted of openings in the providers' calendar. Using this unscheduled appointment waitlist option, patients are alerted through portal messages about times and dates that become available. Waitlist alerts can be sent to patients by email and text message and, for app users, by push notifications. They are presented a self-schedulable date and time slot online or in their patient app, and they have the option to accept or decline the offered slot (Figure 4). If the slot does not suit them, they can decline the offer and defer to other self-scheduling offers that might come up later.

This process can be used by patients who want a sooner visit date than can be booked during their initial scheduling attempt. For example, a patient might want a visit with a specific subspecialist who is in high demand and who has no openings for over 8 weeks. The patient needs to be seen within 4 weeks so elects to be put on the automated waitlist and have offers sent for sooner appointments (Figure 4).

Because it is used for scarce appointments, waitlist self-scheduling can have a significantly different look and feel compared to other self-scheduling processes. The single appointment offer in the waitlist process as seen in Figure 4 is much different than the multitude of scheduled openings when access is plentiful and there are many appointment dates and times to choose from (as seen in Figure 3).

It should be noted that the automated waitlist does not restrict patients from trying to get appointments through a staff scheduler. The staff schedulers work off the same appointment offerings seen by the waitlist algorithm. However, because the waitlist algorithms are not continuously searching for openings (automated searches are scheduled at specific times daily), a recently opened appointment slot may be first visible to a staff scheduler, before the automated search has discovered it. Thus, a staff scheduler may be able to find and
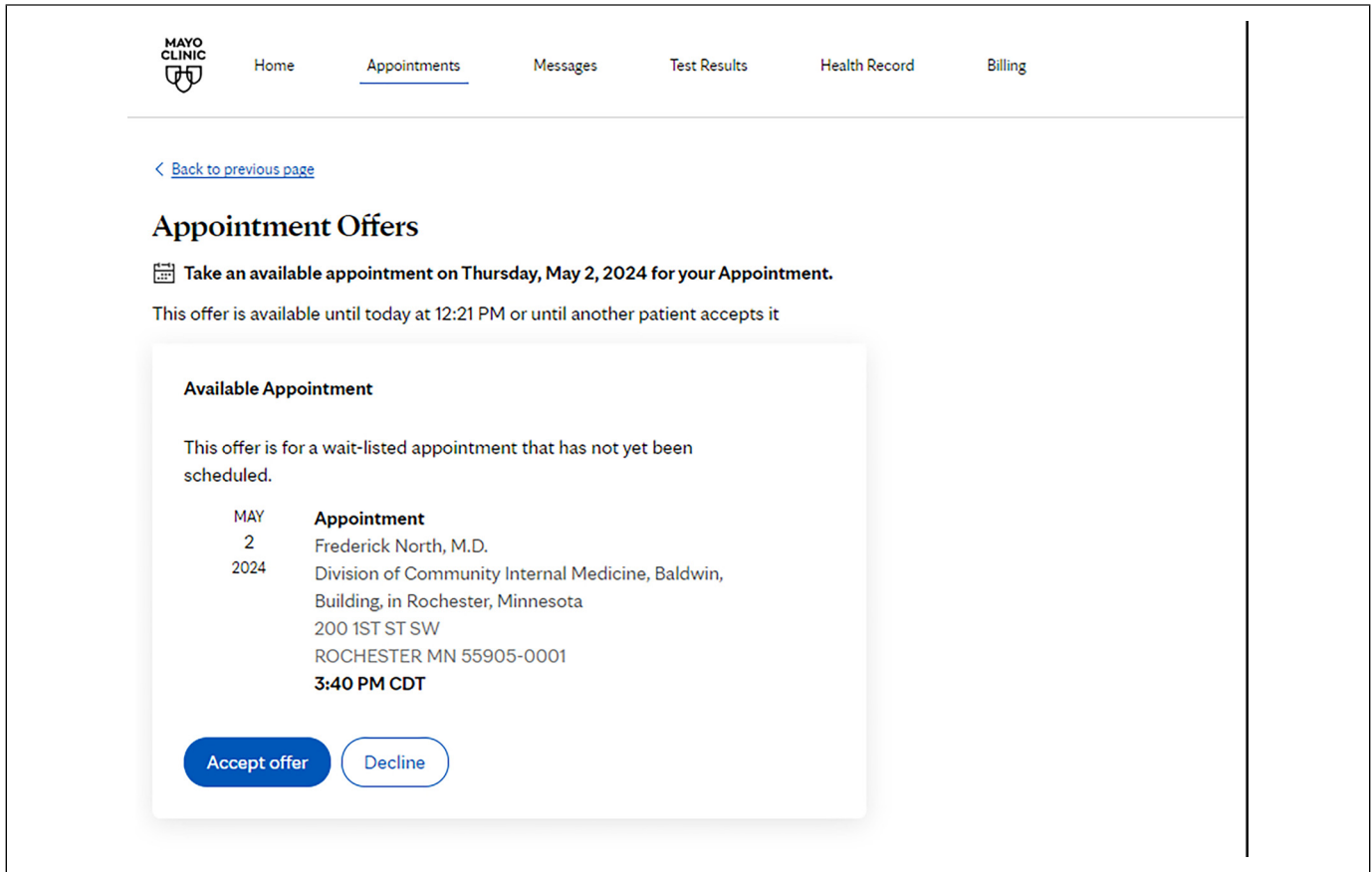
Figure 4. Appointment offer to accept or decline from the automated waitlist self-scheduling process for unscheduled visits.
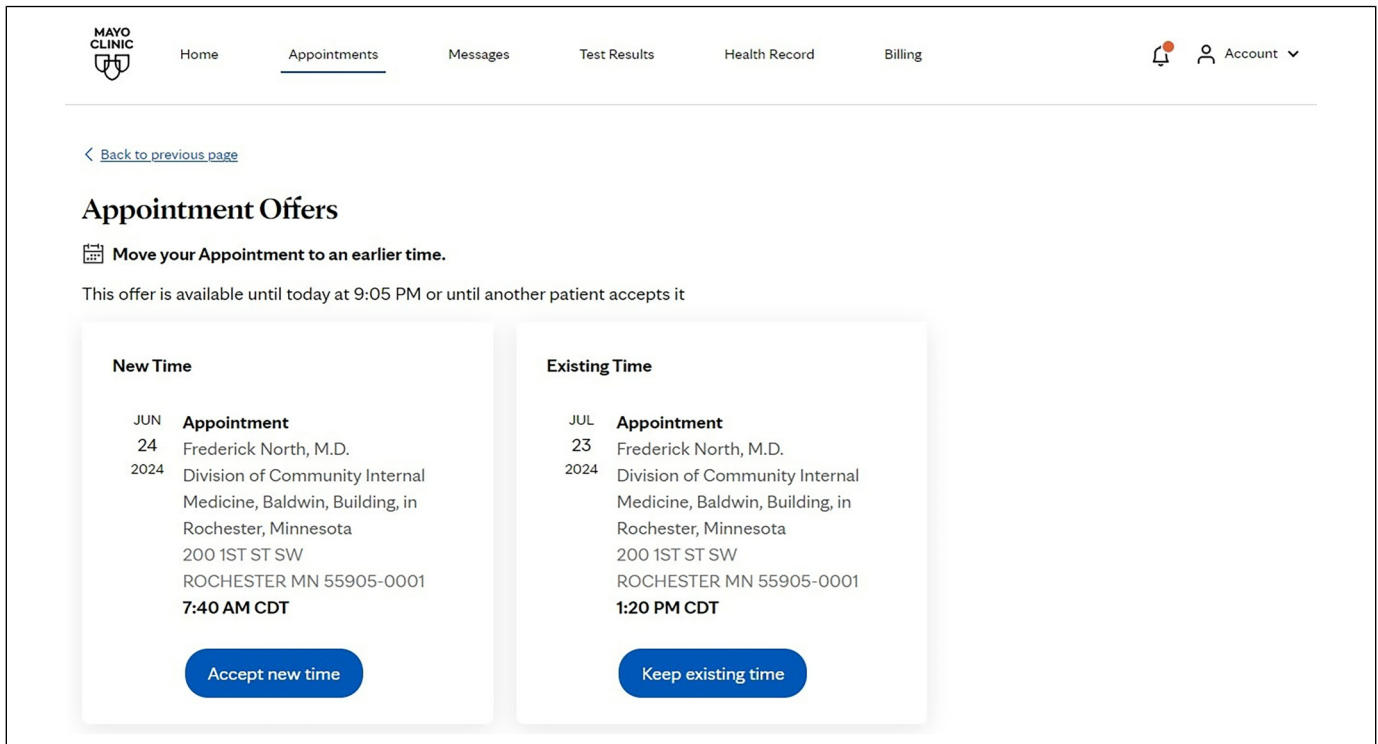

Figure 5. Appointment offer from the automated waitlist self-reschedule for existing appointments. New offer appointment information is placed alongside existing appointment information for patient convenience in comparison.

Figure 6. An example of the reschedule or cancel feature for appointments on the patient portal. Also shown is the automated waitlist self-reschedule option for scheduled visits which is activated here.

schedule an open appointment slot before the automated waitlist software runs its search for that day.

Automated Waitlist Self-Reschedule for Existing (Scheduled) Appointments. Patients also have the option of getting waitlisted when they have scheduled appointments. Unlike the unscheduled appointment waitlist process, these patients already have a

scheduled future visit but may want the opportunity to move up their existing appointment to a date or time that better matches their schedule. The automated waitlist process for scheduled visits can find newly created slots from cancellations that were not available when the patient first scheduled. As with the previously described waitlist process, alerts for new appointment offers can be sent by email, by text message, and, for app users, by push
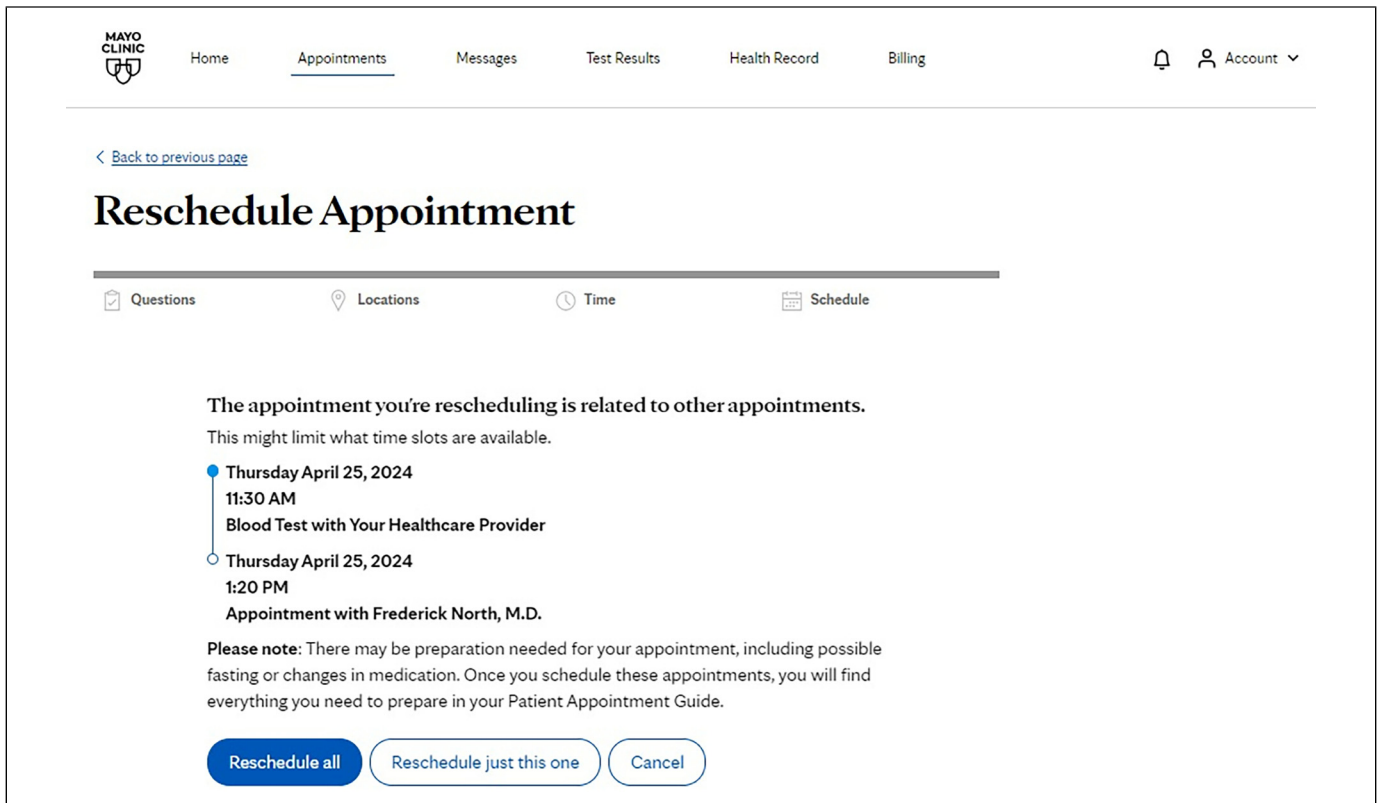
Figure 7. Screenshot of self-reschedule feature that alerts the patient to linked appointments and allows the patient to reschedule all linked appointments as a group reschedule.

notifications. Patients can accept or decline the newly opened appointment. As shown in Figure 5, this waitlist process shows the patient a side-by-side comparison of the new appointment offer with the previously scheduled appointment. Declining the newly offered appointment(s) leaves the previously scheduled appointment intact; the waitlist process continues to seek earlier appointments and sends offers as earlier appointments arise. Offers that are declined or expire become available for other patients.

Example (Figure 5): a primary care patient wants a follow-up visit in a month, but appointment availability is out 3 months. Nevertheless, the patient schedules the visit but also requests to be added to the automated waitlist for sooner offers. After a few days, the patient is alerted to a new message on their portal, and a new date and time that works better is offered. The patient accepts the offer, the new appointment is confirmed, and the automated process cancels the previously scheduled appointment.

Self-Reschedule Option for Existing Appointments (Elective Self-Reschedule). Long phone wait times and inconvenient scheduling hours have been identified as "pain points" for those who schedule provider appointment by phone.[37] Rescheduling by mobile or online allows patients to access their existing appointment and view alternative dates and times without the hassles of telephone wait times or a requirement to call during business hours. This self-rescheduling process can be done quickly, discreetly, and from anywhere. The self-reschedule option

is likely familiar to many who have also rescheduled flights, hotel reservations, and dinner reservations.

Figure 6 shows the selection option when viewing current scheduled appointments on the portal. If "Reschedule appointment" is selected, then a self-scheduling template like Figure 3 appears. In addition, there are also some features built into self-rescheduling that will alert the patient to linked appointments on the calendar that may need to be rescheduled together. Figure 7 shows a screenshot of what the patient sees when attempting a self-reschedule when there are appointments linked together such as lab test and appointment. In Figure 7, an optional clickable "Reschedule all" can be activated, keeping linked visits together, saving patient and scheduler time as well as keeping linked visits appropriately sequenced so that blood work is done before the physician visit as is the case shown here.

Data Collection

Appointment data and self-scheduling process categories for this study were obtained from scheduling information contained in the electronic health record. Data collection extended for the 2023 calendar year, from January 1 to December 31, 2023.

Only completed scheduled visits were counted in this study; no-shows and cancellations were excluded. We did not include visits such as emergency department visits, e-consultations, or other visits that were not scheduled with patients beforehand. Schedulable remote visits via telemedicine were included.

Table 1. Demographic Comparison of Users of Any of the 7 Self-Scheduling Processes to Those Who Did Not Use Any Self-Scheduled Process.

Demographic	Any self-scheduled completed visits, N = 369,519; count (%)	No self-scheduled completed visits, N = 829,439; count (%)	P value[a]
Age (years)			<.0001
0-17	45,343 (12.3)	97,947 (11.8)	
18-34	61,523 (16.7)	120,207 (14.5)	
35-49	73,072 (19.8)	127,305 (15.4)	
50-64	88,045 (23.8)	190,114 (22.9)	
65-74	65,097 (17.6)	157,230 (19.0)	
75-84	29,663 (8.0)	102,213 (12.3)	
85 and up	6776 (1.8)	34,423 (4.2)	
Mean age (95% CI)	47.5 (47.43, 47.58)	51.1 (51.06, 51.16)	<.0001
Gender			<.0001
Female	224,558 (60.8)	419,264 (50.6)	
Race			<.0001
White	332,166 (89.9)	728,531 (87.8)	
Asian	11,602 (3.1)	24,461 (3.0)	
Black	10,538 (2.9)	36,181 (4.4)	
Other race	4948 (1.3)	17,992 (2.2)	
Unknown, chose not to disclose, missing, unable to provide	10,265 (2.8)	22,274 (2.7)	
Ethnicity			<.0001
Hispanic	16,315 (4.4)	52,356 (6.3)	
Not Hispanic or Latino	340,913 (92.3)	748,952 (90.3)	
Unknown, chose not disclose, missing, unable to provide	12,291 (3.33)	28,131 (3.4)	
Proportion portal activated, or pending activation in % (95% CI)	99.1 (99.0, 99.1)	87.8 (87.8, 87.9)	

[a]H[0] (null hypothesis): proportions are equal between patients with any self-scheduled use and never-users of self-scheduling during the study period calendar year 2023.

Table 2. Counts and Percents of Completed Self-Scheduled Visits by Self-Scheduling Process Types.

Process type (year initiated)	Count of completed self-scheduled visits	Percent of total self-scheduled	Cumulative percent self-scheduled
Virtual ticket self-schedule (2019)	341,591	46.56	46.56
Direct self-schedule (2019)	203,593	27.75	74.31
Self-reschedule option (2020)	79,706	10.86	85.18
New patient self-schedule (2022)	54,367	7.41	92.59
Automated waitlist self-reschedule for scheduled visits (self-reschedule a previously scheduled appointment from waitlist offers) (2020)	38,649	5.27	97.85
Automated waitlist self-schedule for unscheduled visits (offer from waitlist to self-schedule an ordered visit not yet scheduled) (2019)	10,939	1.49	99.34
Self-triage self-schedule (2019)	4806	0.66	100
Total	733,651	100	100

Measures

A completed visit met our definition of a process success. Our primary measures were counts and percents of completed visits that had been self-scheduled through the 7 different self-scheduling processes as described earlier.

Statistics and Ethics

Data analysis was done using Stata 18.0 (College Station, Texas). Chi-square was used for differences in demographics. Linear regression was used for examination of rate of self-scheduled use over time. This study was classified as
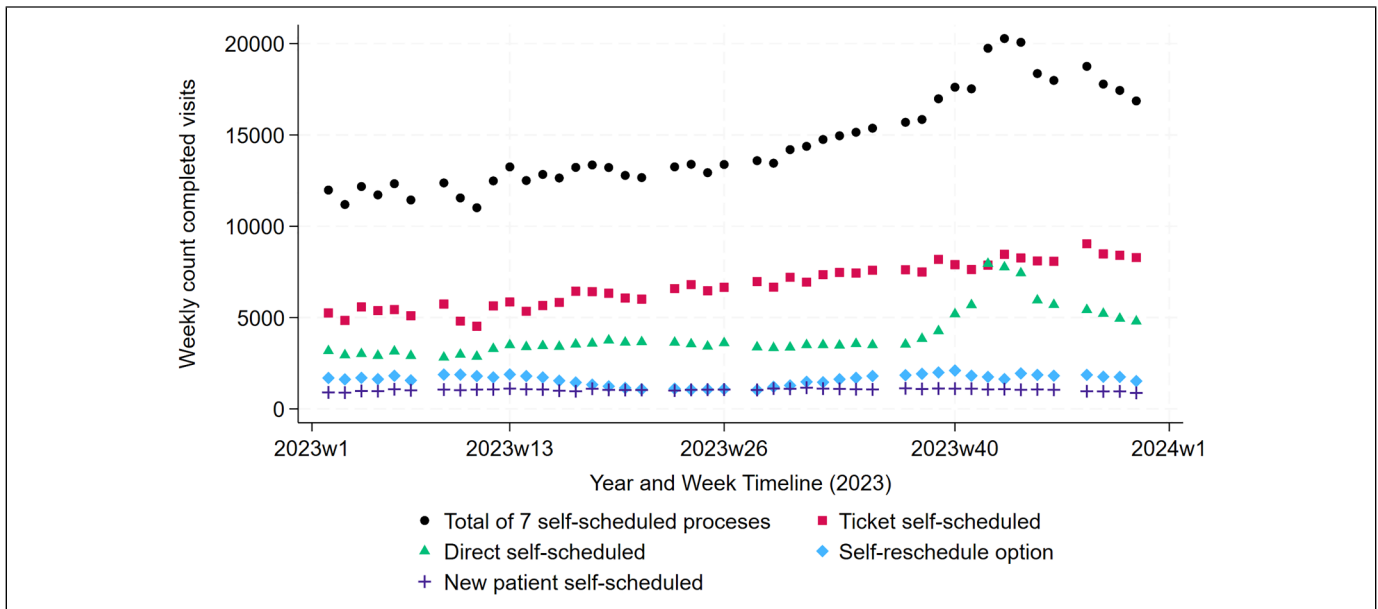
Figure 8. Weekly counts of self-scheduled completed visits. Black dots are the total of all processes. Below the total counts are the weekly completed visit scatter plots over time (by week) of the 4 highest use self-scheduling processes. Weekly counts were omitted for 7 outlier weeks that contained US-recognized holidays including 2023 week 1 (New Year's) and 2023 week 52 (Christmas).

exempt by the Mayo Clinic Institutional Review Board (IRB 20-006809).

Results

Seven separate processes were used in self-scheduling 733,651 completed appointments. Self-scheduling processes were used in 5.44% (733,651/13,481,628) of the nearly 13.5 M completed visits over a year-long study period from January 1 to December 31, 2023. There were 369,519 unique patients of 1,198,958 total patients (30.8%) with scheduled appointments who completed at least one visit that they self-scheduled using at least one of the self-scheduling processes; there were 69.2% (829,439/1,198,958) who were exclusively staff-scheduled.

Demographics of Users

Table 1 shows the demographic comparison of patients having completed visits with any use of the 7 self-scheduled processes compared to patients having completed visits who had not used any of the self-scheduled processes during the study period. The users of self-scheduling were more likely to be younger, female, white, and not Hispanic.

Process Categories With Associated Counts and Percents

Table 2 shows the counts and percents of the 7 categorized self-scheduling process types. Ticket scheduling and direct scheduling accounted for 74% of all self-scheduling.

Adoption and Utilization of Self-Scheduling Processes

The 7 self-scheduling processes were all actively in use at the start of 2023. As indicated in Table 2, the processes did not all start at the same time or even the same year. However, during the 2023 calendar year of our study, these 7 processes generated almost 3-quarters of a million self-scheduled completed visits. The ticket process, direct scheduling, and self-rescheduling processes accounted for 46.6%, 27.8%, and 10.9% of self-scheduling, respectively. These 3 processes accounted for 85.2% of the total completed self-scheduled visits. The other 4 self-scheduling process accounted for 14.8% of the total.

Self-scheduled visits accounted for 5.4% of the overall total completed scheduled visits and that percentage continues to rise. Figure 8 shows the longitudinal weekly counts of the 4 most used processes, along with the total weekly count of all processes.

Total weekly counts of self-scheduled completed visits (without holiday outlier weeks) went from a low of 11,017 to a high of 20,279 for an increase of 84% over the course of 1 year. A linear regression model of completed weekly self-scheduled counts (excluding 7 holiday outlier weeks) showed an adjusted R^2 of .82 with estimated week-by-week increase of 160 self-scheduled visits (95% CI; 138-183, $P < .0001$).

Also excluding the 7 outlier holiday weeks, the weekly direct self-scheduled counts went from 2820 to a peak of 7954 for an increase of 182%. Ticket self-scheduled went from 4526 to 9044 for a 100% increase over the year. The graph in Figure 8 shows a major surge in direct self-scheduling in 2023 during weeks 42, 43, and 44. This was primarily due to

Table 3. Patient Contexts, Resources Needed, Anticipated Results, and Measurables for 7 Different Self-Scheduling Processes.

Self-schedule process name		Process technology requirements (Supplemental Material have additional screenshots of what patients see during the self-scheduling processes)	Anticipated and measurable results
Self-schedule process name	Patient scheduling interests that are served by the self-scheduling process		
	Common to all 7 processes		
	All processes have advantage of no telephone hold times. All have 24/7 convenience. All processes give registered patients immediate confirmation of scheduled appointments	All processes require technology in EHR record and patient-facing portal (web/mobile) which allow patients to see and self-select open appointment slots	All processes are anticipated to decrease clinic phone volumes and staff scheduler time for routine tasks associated with self-scheduled visit types
Ticket self-scheduling	For those who want to choose to either rapidly (or leisurely) view and select available appointment dates and times for already-approved but not-yet-scheduled appointments. Those who desire "one-stop" scheduling by app or online of approved appointment	Creation of virtual ticket to self-schedule. This is initiated with provider order, EHR-automated order (eg screening mammogram due), or scheduler-created request. Virtual tickets also may have visits bundled and sequenced to help patients and providers with well-timed and efficient care	Improved quality measures. Automated tickets generated for screening exams and chronic care (eg mammograms, blood pressure, and diabetes care). Measurable change in uptake of preventive services and adherence to care guidelines
Direct self-scheduling	For those wanting do-it-yourself scheduling of uncomplicated appointments with a few clicks online or mobile. Established patients who desire some continuity of care, which is prioritized in software, but also allows patient choice to see alternative care team provider if available	Needs clickable self-schedulable visits on portal page. Self-schedulable choices for patients are individualized based on age, sex, and other information in EHR. Choices for provider are built into EHR system based on continuity of care criteria and patient choice	Improved patient satisfaction with ease of scheduling. Improved uptake of specific direct scheduled visits (eg vaccinations, cervical cancer screening, and eye exams). Improved patient choice in scheduling
New patient self-scheduling	For those not yet registered as patients who want to minimize typical barriers to getting an appointment with a specialist	Healthcare website viewable by individuals not registered as patients. Forms and algorithms needed for basic information input to allow scheduling to proceed without formal patient registration. Advanced natural language models ensure patients are presented with forms that match diagnoses and/or symptoms	Reduced barriers and decreased time spent by new patients with scheduling process. Decreased wait times for scheduling with appointment specialists
Self-triage self-scheduling	For those wanting symptom-driven recommendations about appointment urgency prior to self-scheduling. 24/7 symptom assessment without triage phone calls	Patient portal self-triage symptom-driven algorithms prior to self-scheduling. Algorithm assesses symptom urgency and gives recommendations for care other than a self-scheduled visit if appropriate.	Successful self-scheduling of appropriate appointments. Redirection to ED when appropriate. Potential avoidance of unnecessary ED visits. Potential decrease in symptom related messaging
Automated waitlist self-schedule (for unscheduled visits)	For those desiring an appointment but there are limited or no available appointment slots. Want appointment options sent to them as they become available. They do not want to call the clinic daily to check for cancellations.	Automated waitlist technology that regularly search visit types for open appointments and sends appointment offers to waitlisted patients. Patient portal with technology for patient alerts to self-schedule appointment offers to self-schedule	Appointment wait time improvement. Improved access to appointments. Fewer unused (empty) appointment slots. Less inbound and outbound scheduler phone volume
Automated waitlist self-reschedule for scheduled visit (self-reschedule based on appointment opening found and offered)	For those with existing scheduled appointment but not at an ideal date/time. Wants visit moved up with visit alternatives automatically sent directly to them. Wants choice to self-reschedule for earlier appointment. They do not want to call clinic daily to check for cancellations	Automated waitlist technology. Patient portal with technology for patient alerts to self-reschedule as offers get sent. Side by side portal comparison of new appointment with previously scheduled appointment	Appointment wait time improvement of accepted offer compared to existing appointment wait time. (ie, sooner appointments). Fewer unused empty slots
Self-reschedule	For eligible scheduled patient who want to view alternative appointments. Click and reschedule 24/7 convenience. No staff scheduler needed	Rescheduling software that includes ability to reschedule linked (bundled) appointments.	Reduced patient no-show rate compared to staff-scheduled. Fewer cancellations. Self-reschedule convenience (% used outside of typical business hours)

seasonal self-scheduling of vaccinations. The impact of self-scheduling vaccinations and its relationship to seasonal self-scheduling surges is addressed in another study.[24]

Discussion

Patient Implications, Resources Needed, and Measurables

Table 3 summarizes how the 7 processes can help patients manage some of their scheduling needs. A few of the informatics resources needed for self-scheduling are listed in Table 3 pertaining to the separate processes. A more thorough examination of self-scheduling complexity and potential resources needed can be found in a study from Mayo Clinic.[21] Anticipated results and process measurables are also identified for each of the self-scheduling processes. Additional screenshots of what patients see with the different processes are included in the Supplemental Material.

Practice Implications

Some of the processes described here have already had a measurable effect on the practice. During the COVID-19 pandemic, self-scheduling of COVID-19 tests was associated with thousands of hours of administrative staff and nurse time saved.[19,20] Beyond COVID-19, direct scheduling for immunizations and respiratory symptom test visits are impacting some seasonal scheduling activity. Four visit types, 3 vaccination and 1 testing type, accounted for 10.6% of all self-scheduled visits at Mayo Clinic.[24] Self-scheduling of screening mammography now accounts for about 30% of all scheduled screening mammograms at Mayo Clinic and over 35% at Johns Hopkins.[13,24] Self-scheduling of screening mammograms also appears to decrease scheduling rework. When these visits are staff scheduled, there was a significantly higher proportion (25.5%) that required staff rework (staff scheduler cancellations and reschedules) than when self-scheduled (6.5%).[14]

Self-triage combined with self-scheduling has had some measurable impact on the practice. Self-triage for ear and hearing concerns has some data to support that it may decrease patient messages about these concerns.[18] Also, for the most part, patients appear to be appropriately using self-triage for low-risk ear and hearing problems but are not necessarily following the self-triage recommendations that would likely safely avoid ED use.[17,18]

Manual waitlists are labor-intensive for scheduling staff who must search for appointment openings and place outbound calls to fill the openings. Automated waitlists can send openings to multiple patients at a time and the first patient to accept the new appointment is automatically scheduled, resolving the original appointment or request. Automated waitlists for medical appointments are not yet well studied but may have a significant impact by saving staff-scheduling time as well as increasing patient satisfaction in scheduling access.

Also not yet well studied is the impact of self-scheduling on patient quality measures. Visit types that are completely automated for self-scheduling such as screening mammography can potentially help practices improve quality measures such as percent of eligible patients who are up to date on screening mammograms. The merit-based incentive payment system of the Centers for Medicare and Medicaid Services has included this screening mammogram process measure for practices to report.[38] Patients due for visits such as screening mammograms can be automatically sent an offer through the patient portal as a reminder to schedule the visit and allows them to complete that action in just a few minutes.

Our results showed unequal uptake of self-scheduling for completed visits across age, race, and ethnicity. It should be noted that scheduled visits that were not attended (no-shows) were excluded from the analysis so we do not know if all self-scheduled visits had similar disparities. Others have noted some self-scheduling demographic disparities. Specifically examining differences in self-scheduling of diagnostic imaging, Ganeshan et al.[39] found significant disparities in self-scheduling by race and ethnicity, as well as by language spoken, and insurance coverage. To meet the goal of the Quintuple Aim to improve health equity, practices will need to find ways to help patients across social and demographic domains with their scheduling needs.[40] Sadeghi et al.[41] suggest that self-scheduling of screening mammography can be combined with other pathways, such as self-referral (referral without provider order), to help decrease health disparity in breast cancer screening.

Appointment no-shows have significant costs.[42,43] A Mayo Clinic study comparing self-scheduled versus staff-scheduled well-child visits showed no significant difference in no-shows.[15] However, no-shows in screening mammograms at Mayo Clinic were significantly higher with self-scheduled (5.7%) versus those staff-scheduled (4.6%).[14] On the other hand, Mayo Clinic self-scheduled nasal swab tests for COVID-19 were significantly lower (2.5%) compared to those staff-scheduled (3.0%).[20] In a large study at Johns Hopkins Community Physicians with nearly 2 M appointment bookings analyzed, no-shows were significantly lower when self-scheduled (2.7%) compared to staff-scheduled (4.6%).[10] Other studies including a systematic review showed decreased no-show rates with self-scheduling.[44–47] Much of the literature on self-scheduling suggests that self-scheduling is associated with lower no-show rates, but it is possible that no-show rates for different self-scheduling methods may vary.

Limitations

Our quantitative results would be difficult to exactly replicate in other practices even with similar patient demographics. Self-scheduling process development has required multiple layers of project management with stakeholders in multiple clinical specialties, IT resources, and collaboration with Epic platform experts. The processes in this study have had staggered rollouts across Mayo Clinic and are continuing to show increased use over time (Figure 8). As self-scheduling becomes more widespread and development of self-scheduling proceeds, we expect that over time, the uptake of self-

scheduling will continue to grow. That said, medical appointment scheduling for specific appointment types can be a very complex process, and there are obstacles to self-scheduling that will remain difficult to overcome.[21] The linear growth of self-scheduling that we have seen in this study was only over 1 year. It is too early to make predictions of future growth of self-scheduling or its ceiling.

We included only completed visit counts in this study. By looking at these completed visit counts, readers can see that self-scheduling is successful in large numbers of visits. Although this study is not widely generalizable, it can help practices decide if specific self-scheduling processes could be successful in their unique practices. It was outside the scope of this study to examine self-scheduling failures so future work needs to examine how and where self-scheduling fails. Also, future work will need to examine if different self-scheduling processes improve no-show rates as suggested by NHS England[12] and other sources noted above. We also did not have patient satisfaction data associated with these different processes to determine whether patient satisfaction was increased with online booking as seen in NHS England.[12]

Self-cancellations also play a role in the self-scheduling process. Our goal was to show the use of multiple self-scheduling processes resulting in completed visits. Self-cancellations by definition do not result in completed visits and were out of scope for this study. However, self-cancellations are also part of patients' ability to manage their medical care and will be analyzed in future work.

It was also outside the scope of the study to examine the impact of technology failures on self-scheduling. Although the patient portal and patient EHR scheduling software are generally very reliable, we do not know the impact of outages which would affect self-scheduling counts. We do know that there were some technical difficulties with the self-rescheduling option during the summer of 2023 which can be seen by the dip in counts at that time (Figure 8).

Conclusion

Seven different self-scheduling processes were used to successfully schedule 733,651 completed visits in 12 months. Self-scheduling processes are increasing in use and giving patients multiple options that can improve the overall appointment scheduling process.

Declaration of Conflicting Interests

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