

# Self-scheduling in a Large Multispecialty and Multisite Clinic: A Retrospective, Longitudinal Examination of Multiple Self-Scheduled Visit Types

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## Abstract

**Background:** Self-scheduling of medical visits is becoming available at many medical institutions. We aimed to examine the self-scheduled visit counts and rate of growth of self-scheduled visits in a multispecialty practice.

**Methods:** For 85 weeks extending from January 1, 2022 through August 24, 2023, we examined self-scheduled visit counts for over 1500 self-scheduled visit types. We compared completed self-scheduled visit counts to all scheduled completed visit counts for the same visit types. We collected counts of the most frequently self-scheduled visit types for each week and examined the change over time. We also determined the proportion that each visit type was self-scheduled.

**Results:** There were 20,769 699 completed visits during the course of the study that met the criteria for inclusion. Self-scheduled visits accounted for 4.0% of all completed visits (838 592/20,769 699). Over the 85-week span, self-scheduled visits rose from 3.0% to 5.3% of the total. There were 1887 unique visit types that were associated with completed visits. There were just 6 appointment visit types of the total 1887 self-scheduled visit types that accounted for 50.7% of the total 838 592 self-scheduled visits. Those 6 visit types were a lab blood test visit (19.5%, 163 K visits), two Family Medicine office visit types (13.0%, 109 K visits), a screening mammogram visit type (6.6%, 55 K visits), a scheduled express care visit type (6%, 50 K visits) and a COVID immunization visit type (5.7%, 48 K visits). Twenty-one visit types that were self-scheduled accounted for 75% of the total self-scheduled visits. Four seasonal visits, accounting for 10.6% of the total self-scheduled visits, were responsible for almost all the non-linear change in self-scheduling.

**Conclusion:** Self-scheduling accounted for a small but growing percent of all outpatient scheduled visits in a multispecialty, multisite practice. A wide range of visit types can be successfully self-scheduled.

## Keywords

self-schedule, access to care, efficiency, health economics, medical informatics, outpatient visits, practice management, specialty visits, family medicine, visit scheduling

## Introduction

Patients are self-scheduling medical appointments with increasing regularity. Self-scheduling use cases have been published for community-based practices,<sup>1,2</sup> dermatology appointments,<sup>3,4</sup> screening mammograms,<sup>5,6</sup> well-child visits,<sup>7</sup> COVID testing,<sup>8-10</sup> and sexual health appointments.<sup>11</sup> Zocdoc and Lybrate are e-health services operating in the US and internationally that schedule patients online with providers by focus on their practice,

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**Table 1.** Description of Seven Mayo Clinic Visit Categories and Examples of Associated Self-Schedulable Visit Types.

Visit Category	Description	Self-schedulable Examples using Specific Schedulable Visit Types
<b>Procedure</b>	Visit types for generally noninvasive or low risk procedures that may generate procedure reports (eg imaging interpretations).	Immunizations. Screening mammography, Bone Mineral Density, and other imaging visits.
<b>Testing</b>	Visit types for collecting, then testing, specimens from patients (generally for visits that generate laboratory test results).	Lab visit - blood test (venipuncture), Lab urine test, Specimen container visit (24 h. urine, stool specimen container, etc.).
<b>Established patient</b>	Visit types for patients who have registered with the clinic and have had previous visits. Includes visits to specialists after initial consultation and visits to primary care for ongoing care.	Primary care visits for those previously seen in Family Medicine, Pediatrics and Community Internal Medicine; Specialty visits in Cardiology, Dermatology, Gynecology, Obstetrics, Orthopedics, Psychiatry, etc.
<b>Therapy</b>	Visit types for patients with recurring visits that include specific therapy.	Physical therapy and Psychotherapy appointments.
<b>New patient</b>	Visit types for patients who have not previously had completed appointments at the clinic, or have not had visits in the desired specialty, or in primary care; the request for this appointment can be from the patient or from a non-Mayo Clinic clinician.	Patient visits for those never seen before in Dermatology, Obstetrics, Optometry, etc.
<b>Consultation</b>	Visit types for established patients (not new) who are getting a specialty visit for consultation (limited to specialists who generally are not assuming responsibility for patient primary care); the request is from a Mayo Clinic clinician in another division or department.	Consultations in specialties (Cardiology, Gastroenterology, Neurology, etc.).
<b>Return</b>	Visit types for established patients who are returning as part of a follow up review/evaluation. Clinicians may use this visit category for additional visits needed to follow up after an initial consultation or new patient visit following completion of tests, procedures, and additional consultations.	Return visit to a specific sleep medicine provider who did the initial history, examination, and ordered a sleep study. Return visit would be scheduled with the same sleep medicine provider after the overnight sleep study had been completed. Return visit to a the same dermatologist after skin biopsy and dermatopathology completed, etc.

specialty, and location.<sup>12–14</sup> The National Health Service (NHS) in the United Kingdom (UK) offers self-scheduling, with the ability to access healthcare online to “book, check or cancel appointments with a GP, nurse or other healthcare professional.”<sup>15</sup> Some virtual healthcare services such as Teledoc and Virtuwel advertise 24/7 access to providers.<sup>16,17</sup> Teledoc, in addition to on-demand visits, has scheduled telehealth visits with patient input of convenient times and option to cancel a scheduled appointment.<sup>16</sup>

Some of the first use cases of self-scheduling did not show a large patient uptake. In 2007, 10% of the sexual health clinic bookings in an NHS clinic were self-scheduled.<sup>11</sup> In a small sample study of an Australian primary healthcare practice published in 2014, only 11% reported using self-scheduling.<sup>2</sup> This same practice had reported self-scheduling uptake at 4% in 2012.<sup>18</sup> However, some self-scheduling visit types show uptakes of 35% or more. In the United States (US), Johns Hopkins efforts at self-scheduling screening mammogram visits has seen their percent of self-scheduled screening mammograms increase tenfold, from 3.7% to 37% over eight years of use.<sup>5</sup> At Mayo Clinic in the US, 44% of COVID PCR nasal swab visits were self-scheduled during the peak month of January 2022.<sup>10</sup> In contrast to this, a report on self-scheduling for dermatology adult follow up visits at Massachusetts General Hospital Dermatology showed an initial uptake of only 1.1% (1303/117 962) of return visits being self-scheduled over a 19-month period starting on January 1, 2018.<sup>4</sup>

Mayo Clinic has developed and implemented self-scheduling for a number of visit types. Our aim with this study was to examine the longitudinal trends associated with self-scheduling and the variety of visit types that have been associated with self-scheduling in a multispecialty, multisite medical practice.

## Methods

### Setting

This study took place at Mayo Clinic, a multispecialty, multisite clinic with locations in the US and internationally. Mayo Clinic employs several thousand healthcare providers and schedules visits for a wide variety of patients, from newborns to supercentenarians. Mayo Clinic has both a large number of specialty and subspecialty practices covering a broad scope of specialty care, as well as primary care practices in pediatrics, family medicine, and internal medicine.

### Scheduling Terminology at Mayo Clinic

Appointments that require patient presence to complete (such as clinician visits or diagnostic testing) and thus require patient input to schedule are split into seven mutually exclusive categories. Each of these visit categories has hundreds of more specific unique visit types. The unique visit type is the foundation for scheduling; it contains

the basic information needed for staff-schedulers or self-schedulers to successfully schedule a visit. The unique visit type is required to link to specific scheduling templates so that patients get matched to the correct location, correct specialty or service, and the correct resources for their healthcare visit. This level of detail requires a high level of specificity in each unique visit type. Mayo Clinic has created and used over 9000 unique visit types to successfully schedule visits from January 1, 2022 through August 24, 2023.<sup>19</sup>

Table 1 contains the descriptions of the 7 visit categories and has examples of self-schedulable visit types associated with the visit categories.

### *Self-Scheduling at Mayo Clinic*

Self-scheduling at Mayo Clinic started in 2019 for well-child exams.<sup>7</sup> Screening mammograms were one of the next visit types to be self-scheduled.<sup>6</sup> These visit types have national guidelines that help direct patients and medical practices to consensus guided scheduling of these appointments.<sup>20,21</sup> As such, some of the complexity and barriers associated with self-scheduling are not encountered.<sup>19</sup>

Screening mammograms and well-child exams at Mayo Clinic are categorized as procedure visits and established patient visits, respectively, as described in Table 1. Over the next several years, visit types belonging to additional visit categories were made self-schedulable. Creating the ability to self-schedule a visit requires significant information technology (IT) support and changes in practice processes. Choosing which visit types should have a self-scheduled option and when and where the rollout should occur involves multiple stakeholder groups and multiple layers in project management.

To date, Mayo Clinic patients have successfully completed self-scheduled visits in all seven major visit categories described in Table 1.

### *Data Collection and Inclusion/Exclusion Criteria*

Data collection was from January 1, 2022 through August 24, 2023. The Mayo Clinic Enterprise Office of Access Management provided the data for all patient care appointments during the study period. This included patient demographics, appointment visit type, date visit scheduled, status of visit completion (whether no-show or not), and a dichotomous variable of self-scheduled or staff-scheduled. Data was collected from the Epic® electronic health record used by Mayo Clinic.

All scheduled appointments for patient care were included in the initial data. We were interested in self-scheduled visits that were successfully completed, so only scheduled visits that were completed were kept for the analysis. Thus, no show visits, either self-scheduled or staff-scheduled, are not included in the analysis. This study focused solely on scheduled visits so walk-in, emergency department, and other nonscheduled visits were not included.

### *Measures*

Counts of completed self-scheduled appointments by specific visit type, percentage of total completed scheduled visits that

were self-scheduled, and percentage of specific visit types that were self-scheduled were primary measures. Other measures were weekly visit totals, self-scheduled highest weekly counts for each visit type, and percentage of total self-scheduled visits by specific visit types.

### *Statistics and Ethics*

We used Stata 18.0 (College Station, Texas, USA) for the data analysis. Chi-Square was used for differences in counts between categories. We used linear regression to examine trends of self-scheduled visit counts and self-scheduled percentages of total scheduled visits over time. This study was classified as exempt by the Mayo Clinic Institutional Review Board (IRB 20-006809)

### *Results*

There were 20,769 699 completed visits during the course of the study that met the criteria for inclusion. Self-scheduled visits accounted for 4.0% of all completed visits (838 592/20,769 699). There were 1887 unique visit types that were associated with completed self-scheduled visits.

A small fraction of self-scheduled visit types accounted for the majority of the self-scheduled visits. There were just 6 appointment visit types of the total 1887 self-scheduled visit types that accounted for 50.7% of the total approximately 838 thousand (K) self-scheduled visits. These 6 accounting for the 50.7% were a lab blood test visit (19.5%, 163 K visits), two Family Medicine office visit types (13.0%, 109 K visits), a screening mammogram visit type (6.6%, 55 K visits), a scheduled express care visit type (6%, 50 K visits) and a COVID immunization visit type (5.7%, 48 K visits). Twenty-one self-scheduled visit types accounted for 75% of the total self-scheduled visits and 66 visit types accounted for 90% of the total self-scheduled visits. The remaining 1821 visit types only accounted for 10% of the total self-scheduled visits.

### *Demographics Self-Scheduled Compared to Exclusive Staff-Scheduled Visits*

Demographics of patients who self-scheduled compared to staff-scheduled are shown in Table 2. Self-schedulers were significantly more likely to be younger, female, white, and less likely to be Hispanic.

### *Seasonal Self-Scheduled Visit Surges*

Figure 1 shows the counts of self-scheduled visits week by week over the course of the study. The upper plot (blue round) in Figure 1 is a scatterplot of weekly counts of the total of all self-scheduled visits and shows several peaks in self-scheduled visits during the 85-week study period. Our analysis showed that the peaks in self-scheduling were mostly due to 4 seasonal self-scheduled visit types. These 4 types were 3 visit types related to immunizations, and 1 testing visit type for

**Table 2.** Demographics of Patients who Completed any Self-Scheduled Visits Compared to Patients who Exclusively Used Staff to Schedule Their Completed Visits (Exclusively Staff-Scheduled).

Demographic	Any Self-scheduled, N = 342 069; count (%)	Exclusively Staff-scheduled, N = 1,041,865; count (%)	p value*
<b>Age (years)</b>			<0.0001
<b>0-17</b>	47 080 (13.8)	120 065 (11.5)	
<b>18-34</b>	58 546 (17.1)	163 597 (15.7)	
<b>35-49</b>	66 995 (19.6)	165 711 (15.9)	
<b>50-64</b>	79 063 (23.1)	238 339 (22.9)	
<b>65-74</b>	56 919 (16.6)	189 354 (18.2)	
<b>75-84</b>	26 414 (7.7)	122 257 (11.7)	
<b>85 and up</b>	7052 (2.1)	42 542 (4.1)	
<b>Mean age [95% CI]</b>	46.55 [46.48, 46.63]	50.52 [50.48, 50.57]	<0.0001
<b>Sex</b>			<0.0001
<b>Female</b>	207 580 (60.7)	524 896 (50.4)	
<b>Race</b>			<0.0001
<b>White</b>	313 521 (91.7)	906 995 (87.1)	
<b>Asian</b>	10 868 (3.2)	30 114 (2.9)	
<b>Black</b>	9281 (2.7)	46 404 (4.5)	
<b>Other race</b>	4374 (1.3)	25 800 (2.5)	
<b>Unknown, choose not disclose, missing unable to provide</b>	4025 (1.2)	32 552 (3.1)	
<b>Ethnicity</b>			<0.0001
<b>Hispanic</b>	14 251 (4.2)	65 860 (6.3)	
<b>Not Hispanic or Latino</b>	322 086 (94.2)	935 203 (89.8)	
<b>choose not disclose, unknown, unable to provide</b>	5732 (1.7)	40 802 (3.9)	
<b>Proportion Portal activated in % (95%CI)</b>	Not applicable; portal account required for >99% of all self-scheduling	74.5 (74.4, 74.6)	

\*P value of null hypothesis that demographics values of self-scheduled = staff-scheduled; 95%CI = 95% confidence interval.

upper respiratory symptoms. These 4 visit types counts were summed together and plotted as the lower plot (red diamond) in Figure 1. When compared with staff-scheduling, the 4 seasonal visit types were more often self-scheduled; 51.4% self-scheduled (89 244/173 715) compared to 48.6% staff-scheduled (84 471/173 715). In terms of the overall impact of these 4 visit types on **all** self-scheduled visits, they accounted for 10.6% of all self-scheduled visits (89 244/838 592).

The impact of these self-scheduled surges (graph peaks) was considerable. The maximum completed self-scheduled visits occurred midway through the study at the peak in Figure 1 (2022, week 43). At that self-scheduled maximum, 36.3%

(5132/14 138) were from the three immunization visit types (the testing visit type had decreased to only 42 visits that week). The longitudinal course of each of these 4 influential visit types can be seen in more detail in a subsequent graph.

Figure 2a shows what the increase in self-scheduled visits looks like without the contribution associated with the 4 seasonal visit types. Figure 2a shows the total self-scheduled minus the sum of the weekly counts of the 4 self-scheduled seasonal visits shown in Figure 1. In graphical terms, the plot in Figure 2a is the result of subtracting the lower tracing in Figure 1 from the upper tracing in Figure 1. In Figure 2a, we also removed 10 outlier weeks that were associated with low visit counts during US national holidays (Christmas, Thanksgiving, Independence Day, etc.) With the removal of the 4 seasonal visit types and 10 holiday week outliers, Figure 2a shows the increase in self-scheduled counts had a nearly linear relationship with the timeline. This is shown in Figure 2a where the red spikes are the 95% confidence intervals for the linear regression best fit for the self-scheduled count data. The adjusted  $r^2$  for the linear regression model was .95 with an estimated week-to-week increase in self-scheduled visits of 84 (95% CI, 80 to 88). This results in a 95% confidence interval estimated increase of 4160 to 4576 self-scheduled visits per year after subtracting seasonal surges.

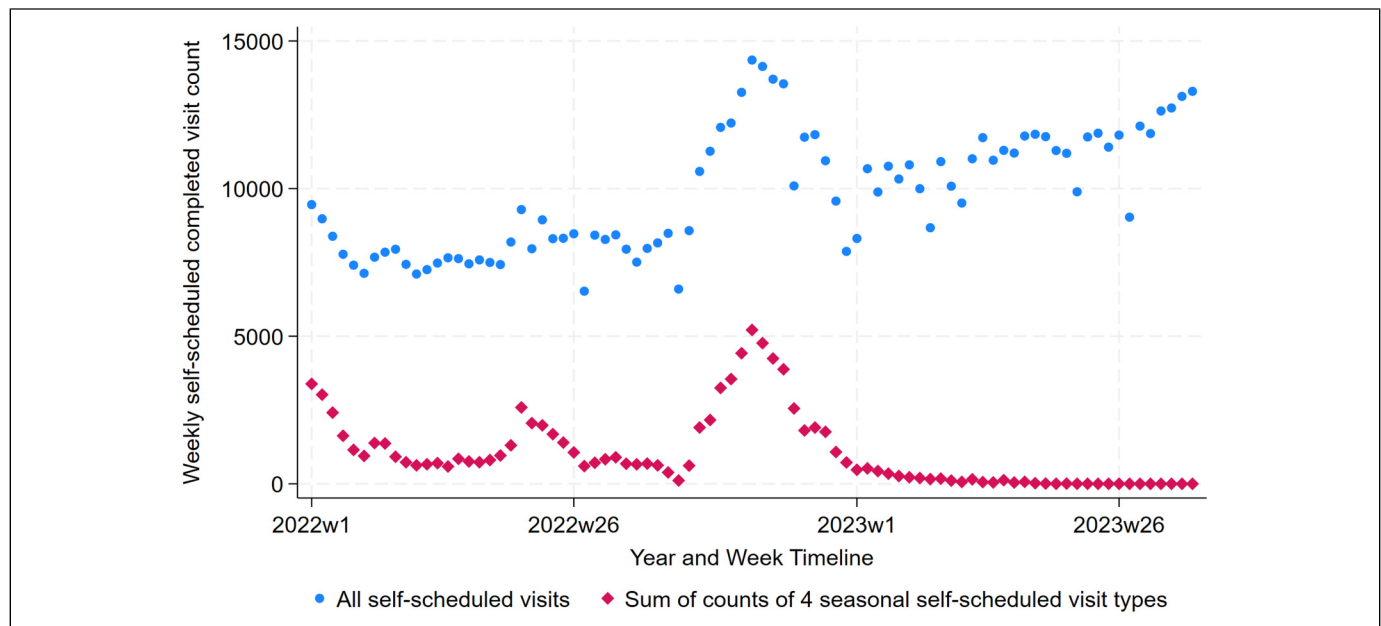
Figure 2b shows the percent of all visits that were self-scheduled (blue round markers) and the self-scheduled percent without the self-scheduled 4 seasonal visit types (red hollow squares). During late spring 2023 and summer of 2023 there were no significant seasonal surges for immunizations or respiratory screening so the two scatterplots coincide. The calculated self-scheduled percent scatterplots look similar to the self-scheduled counts shown in Figure 1 and Figure 2a because the denominator used for the percents (total scheduled visit counts) stayed relatively stable week by week.

Figure 2b illustrates the impact of the influential seasonal self-scheduling visit types. At 2022 week 43, the peak seasonal surge resulted in 5.5% of completed visits that were self-scheduled. For the same week, the self-scheduled percent without the seasonal 4 visit types was only 3.5%. Thus, during that seasonal surge of 2022 week 43, 2% of all scheduled visits (5213/261 521) were self-scheduled using just 4 visit types.

A nearly linear increase in percent self-scheduled is demonstrated when the 4 seasonal visit types are removed (shown by the 95% confidence interval spikes for linear fit). When the 4 seasonal visits are removed, the linear regression adjusted  $r^2$  is .96 and the estimated increase in percent self-scheduled per week is 0.032 (95% CI .030 to 0.033). The estimated yearly increase in percent self-scheduled visits, adjusted by subtracting out seasonal surges, is between 1.59% and 1.75% with 95% confidence. Figure 2b shows that the self-scheduled visits increased from 3.0% to 5.3% of total visits over the 85 weeks of the study.

### Ranked Self-Scheduling Visit Types

Table 3 shows the top 30 ranked self-scheduling appointment types by highest weekly count of self-scheduled visits. Mayo



**Figure 1.** Scatterplots of weekly self-scheduled completed visit counts for 85 consecutive weeks. The two different markers represent the total self-scheduled weekly completed visit counts (blue, round) and the sum of self-scheduled visit counts from 4 seasonal visit types (3 self-schedulable immunization types and 1 self-schedulable respiratory testing), marked by red diamonds.

Clinic continues to add visit types to its inventory of self-schedulable appointments so there were self-scheduled visits implemented towards the end of the study period that had a significant impact on scheduling. If we ranked self-schedulable visit types by counts averaged over the entire 85 weeks, some very successful visit types that were more recently implemented would not appear very successful. To give a better accounting of the influential visit types that were implemented later in our study period, along with the influential seasonal surge visit types, we decided to examine self-schedulable visit types by their highest weekly number of completed self-scheduled visits. Sorting for the visit types with the highest weekly number of completed visits for each of the 1887 self-scheduled visit types over all 85 weeks, we found 30 visit types whose highest weekly self-scheduled count was greater than 95. These are shown in Table 3 and highest weekly visit counts ranged from 96 to 2884 in these 30 top ranked self-scheduled visits (Table 3, column 3).

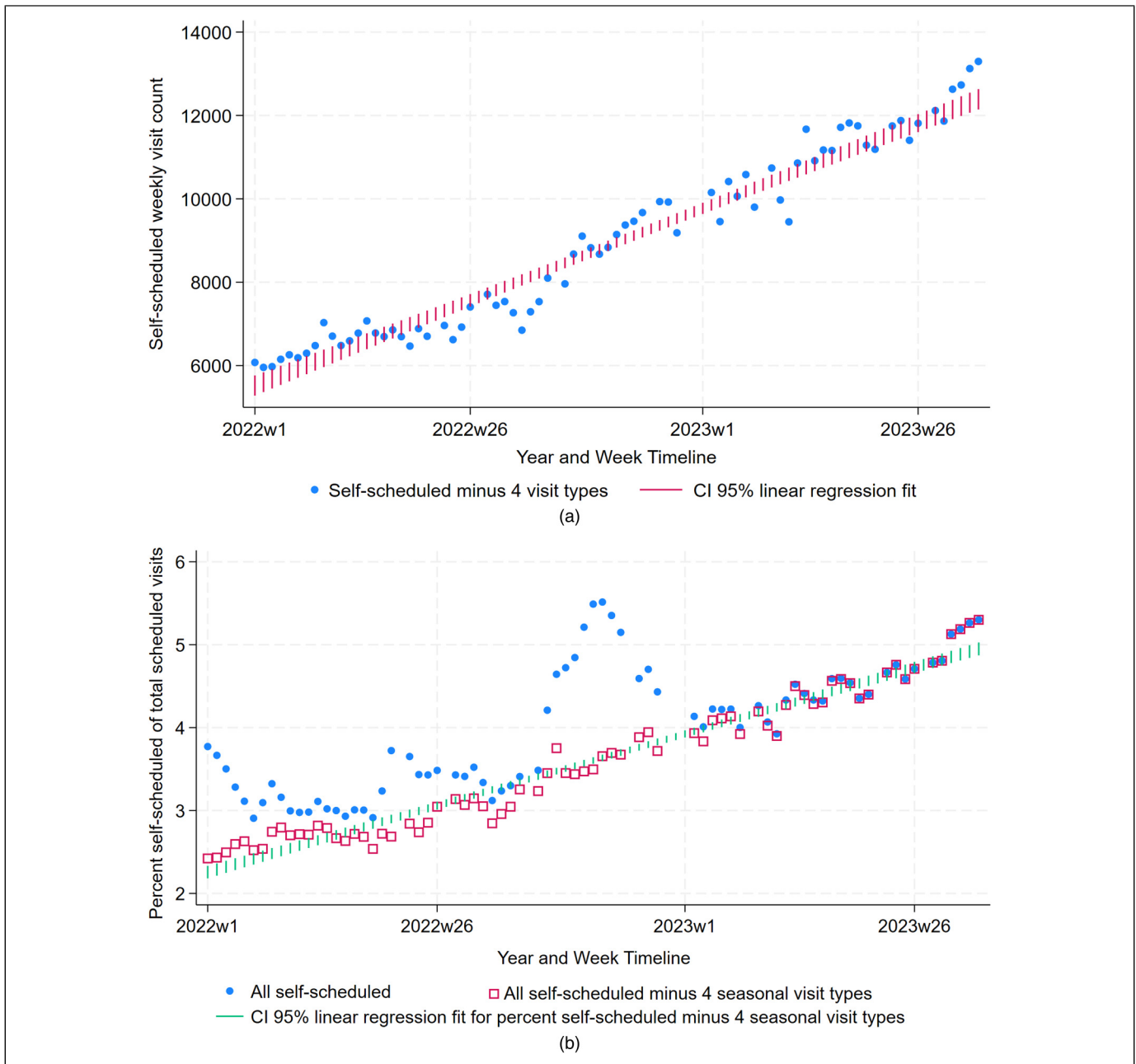
Table 3 column 2 is the Mayo Clinic visit category as described in Table 1. The final column refers to subsequent Figures that show subgraphs of the specific visit types in Table 3.

The 30 self-schedulable visit types in Table 3 accounted for 78.8% (660 866/838 592) of the total completed self-scheduled visits. This table of 30 visit types includes visits for established patients, testing, procedures, and therapy visits. Notably absent from this list of 30 are any visit types from the following visit categories described in Table 1: new patient, consultation, and return visits.

Self-scheduled visit types have been completed for all 7 visit categories described in Table 1, but not all reached the weekly

visit counts of greater than 95 to be included in Table 3. New patient visits in optometry, gynecology and sleep medicine are examples of visit types with completed self-scheduled visits but reached highest weekly visit counts of only 53, 39, and 20, respectively. Consultations have also been successfully self-scheduled in ophthalmology, sleep medicine, and gastroenterology, at highest weekly visit counts of 49, 28, and 22 respectively. The return visit category has been successfully self-scheduled with dermatology and cardiology return visits with highest weekly counts of 50 and 20 respectively. In another study of self-scheduling we address the considerable challenges associated with creating and maintaining self-schedulable visits.<sup>19</sup>

Table 3 contains two visit types that were created specifically for self-scheduling. These were the influenza immunization visit and the URI (upper respiratory infection) swab visit. These are identified in Table 3 with a superscript 2 in column 1 and noted in the Table 3 footnotes. These 2 visit types ranked fourth and 15th respectively in Table 3 and were about 90% self-scheduled. These visit types were also given prominent display in the online patient portal and required just a click to initiate self-scheduling. The influenza immunization visit type also had some software generated invitations sent with a link to self-schedule. The ability to self-initiate self-scheduling a flu vaccine combined with a software generated message “nudge” and link to self-schedule appeared to be a potent combination for patients to self-schedule their influenza vaccination. It should be noted that staff-schedulers could aid in scheduling or rescheduling these 2 visits if needed, explaining why these visit types specifically designed for self-scheduling are not 100% self-scheduled.



**Figure 2.** (a) Scatter plot of total self-scheduled weekly completed visit counts minus the sum of the weekly counts of 4 seasonal visit types (3 self-schedulable immunization visit types and 1 self-schedulable respiratory testing visit type). The blue round markers on this graph are the graphic representation of Figure 1 blue round marker counts minus Figure 1 red diamond counts. Outlier 10 holiday weeks are omitted from the scatterplot figure. Red spikes on this graph are the 95% confidence intervals for the linear regression best fit. (b). Scatterplots show percent self-scheduled by week. Blue round markers represent the percentage of visits that were self-scheduled ( $100 \times \text{count of all self-scheduled visits} / \text{count of all scheduled visits}$ ). Red hollow squares are the percentage of all visits that were self-scheduled minus the 4 self-scheduled seasonal visit types ( $100 \times (\text{count of all self-scheduled visits minus sum of counts of 4 seasonal self-scheduled visits}) / \text{count of all scheduled visits}$ ). Green spikes are the 95% confidence intervals for the linear regression fit of the red hollow squares. Outlier 10 holiday weeks are omitted from the scatterplots.

In Table 3 there were only 6 other visit types that had self-scheduling percentages greater than 40%. These were 4 immunization visit types, 1 screening test visit type and 1 self-schedulable Mayo Express Care visit type. Mayo Express Care is a convenience clinic that addresses a subset of acute

symptoms, minor illnesses, and sports physicals. Unlike other visit types in Table 3, these 6 visit types had additional processes to obtain a visit that did not involve either self- or staff-scheduling. Express Care had unscheduled walk-ins; immunizations and respiratory screenings were also done as an

**Table 3.** Thirty Self-Scheduled Visit Types Ranked by Highest Weekly Count of Completed Self-Scheduled Visits. the Table Contains Visit Types That Reached a Highest Weekly Count of More Than 95 Self-Scheduled Visits.

Appointment Visit Type	Visit Category, as described in Table 1	Highest weekly self-scheduled count, ie maximum weekly count attained for this appointment type	Percent of this appointment type that was self-scheduled (denominator is total scheduled for this appointment type)	Total count self-scheduled for this appointment type	Percent of all self-scheduled visits (total self-scheduled by visit type divided by all self-scheduled, ie 838 592)	Figure(s) that contain the visit type subgraph
Lab visit - blood draw	Test	2884	6.5	163 511	19.5	3,6
Immunization COVID <sup>1</sup>	Procedure	2288	45.3	47 789	5.70	3
Immunization COVID + flu <sup>1</sup>	Procedure	2278	52.9	17 945	2.14	3
Immunization influenza <sup>2</sup>	Procedure	1978	89.8	12 833	1.53	3
Screening visit – COVID test <sup>1</sup>	Test	1322	53.3	10 677	1.27	3
Family Medicine visit	Established	1202	13.4	65 569	7.82	3,6
Express Care visit <sup>1</sup>	Established	942	72.8	50 260	5.99	
Breast cancer screen – radiology visit	Procedure	859	28.5	54 944	6.55	4,6
Family Medicine visit- long visit	Established	747	14.7	43 382	5.17	
Family Medicine periodic (or annual) exam	Established	600	17.9	32 569	3.88	4
COVID initial immunization <sup>1</sup>	Procedure.	477	44.2	3687	0.44	
Medicare wellness visit	Established	403	8.0	4125	0.49	4
Lab visit - urine test	Test	373	3.9	20 421	2.44	
Pediatrics well child	Established	312	21.1	17 988	2.15	4
URI swab specimen collection visit <sup>2</sup>	Established	312	91.7	6282	0.75	4
Community Internal Medicine visit	Established	304	11.3	15 998	1.91	
COVID 3 week booster	Procedure	304	30.0	3837	0.46	
Family Medicine well child	Established	296	19.0	16 366	1.95	4,6
Family Medicine Nurse visit	Established	259	11.0	15 614	1.86	
COVID immunization <sup>1</sup>	Procedure	228	47.2	2180	0.26	
Ophthalmology visit	Established	204	5.1	8288	0.99	5
Psychotherapy	Therapy	191	10.2	4410	0.53	5,6
Community Internal	Established	184	24.1	9241	1.1	

(continued)

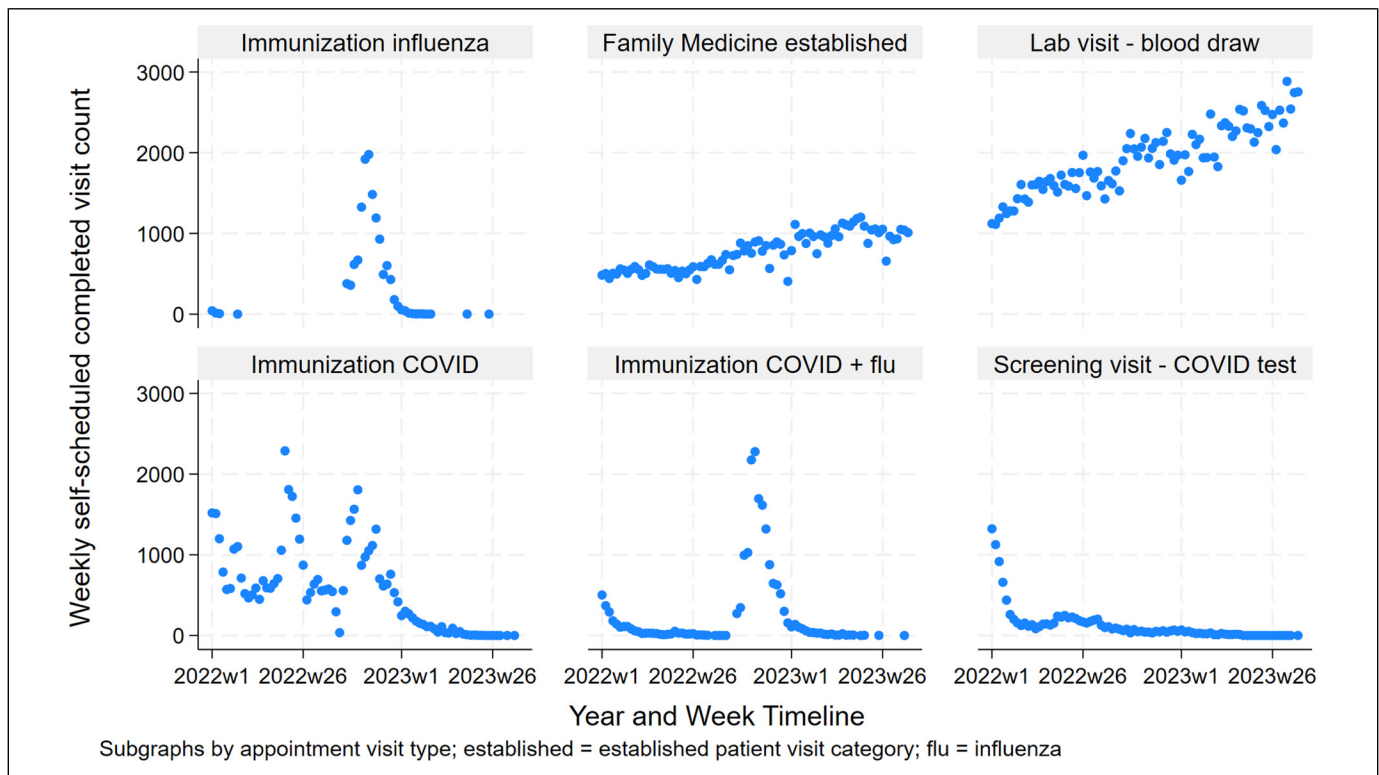
**Table 3.** (continued)

Appointment Type	Visit Category, as described in Table 1	Highest weekly self-scheduled count, ie maximum weekly count attained for this appointment type	Percent of this appointment type that was self-scheduled (denominator is total <u>scheduled</u> for this appointment type)	Total count self-scheduled for this appointment type	Percent of all self-scheduled visits (total self-scheduled by visit type divided by all self-scheduled, ie 838 592)	Figure(s) that contain the visit type subgraph
Medicine - long visit						
Community Internal Medicine periodic exam	Established	148	16.2	7210	0.86	
Orthopedics visit	Established	138	3.2	6016	0.72	5
Psychiatry visit	Established	136	15.1	4885	0.58	5,6
Pediatric visit	Established	107	14.5	5066	0.6	
Dermatology visit	Established	102	5.6	5134	0.61	5
Acupuncture therapy	Therapy	100	9.5	1353	0.16	
Rheumatology visit	Established	96	8.0	3286	0.39	5

<sup>1</sup>Visit types that have other scheduling processes than staff-scheduling or self-scheduling (eg walk-ins that do not require scheduled appointments). Unscheduled visits are not included in the denominator used to calculate the self-scheduled percent (column 4).

<sup>2</sup>Visit types intentionally designed for self-scheduling and with only limited option to initiate staff-scheduling for this visit type.

Abbreviation: URI = upper respiratory infection.



**Figure 3.** Scatterplots of weekly self-scheduled completed visit counts for 85 consecutive weeks. Six self-schedulable appointment visit types are shown. Each visit type reached a highest weekly completed self-scheduled visit count of 1000 or greater during the 85 weeks.



unscheduled add on service to another appointment. We did not have the unscheduled visit counts to add to the denominator for a total count of all visits so the percentages in Table 3 are for self-scheduled out of total **scheduled** visits only, not the self-scheduled percent of **all** (scheduled and unscheduled) visits of the same type. Thus, the self-scheduled percentages for these 6 visits are relevant only in relation to staff-scheduled since the denominator is self-scheduled + staff-scheduled visits and not total visits for these types.

**Self-Scheduled Visit Counts Over Time**

Figures 3 to 5 show scatterplots of selected visit types from the ranked 30 in Table 3. The scatterplots show the variability of self-scheduled use over time.

Figure 3 shows the 4 individual visit types that when summed made up the lower plot in Figure 1 and are the second, third, fourth and fifth ranked visits in Table 3. The 3 immunizations (influenza, COVID, and combined COVID+flu) show how weekly counts of each were quite volatile, going from 0 self-scheduled visits per week to seasonal highs around 2000 self-scheduled visits per week. Also shown in Figure 3 were the visit types for family medicine established patients and lab visit-blood draws. These were examples of highly used self-scheduling visit types that did not have seasonal surges.

Figure 4 shows visit types that were made self-schedulable at different times. Breast cancer screening, pediatrics and family medicine well child exams were 3 of the first self-schedulable

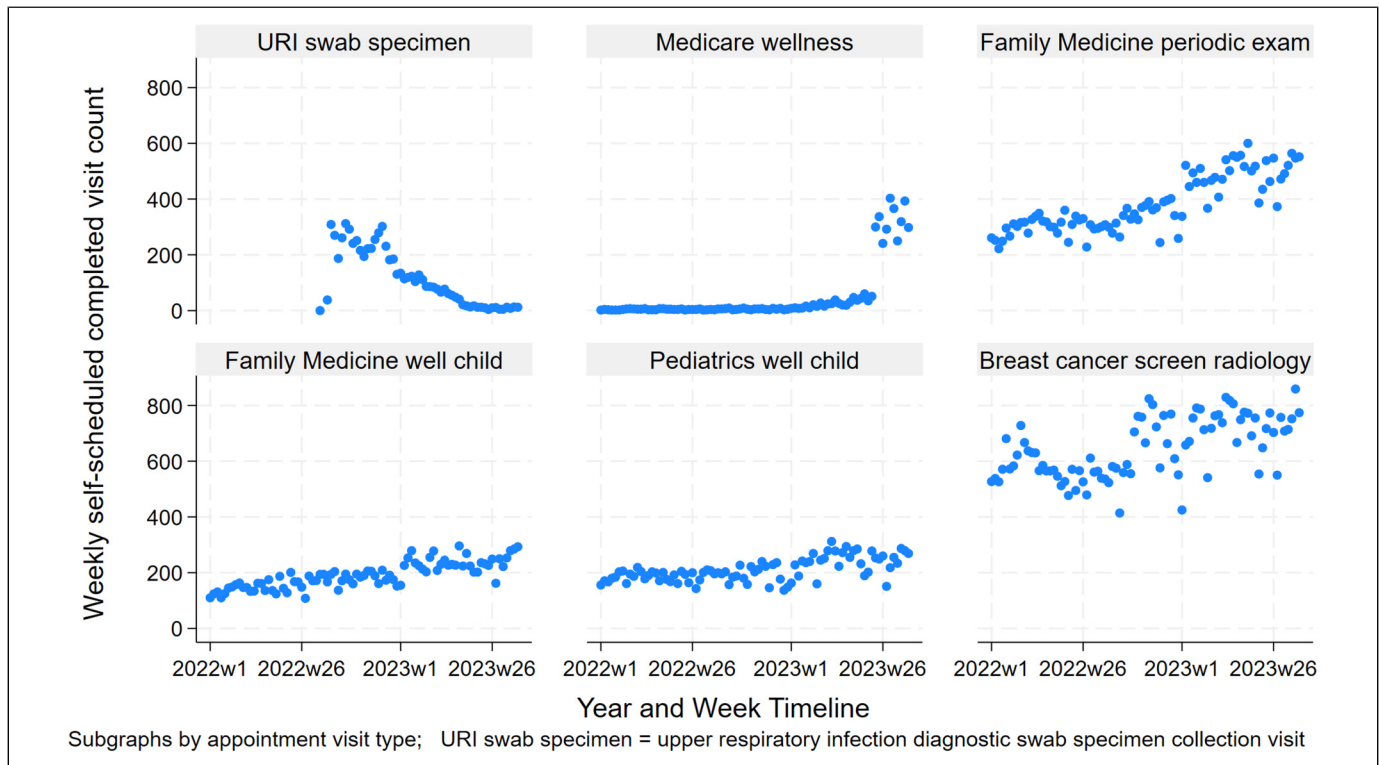
visit types at Mayo Clinic, starting in 2019. The slowly increasing counts in these visit types may indicate some saturation for these self-schedulable visits occurring after several years of use. On the other hand, the upper respiratory testing visit shows a seasonal spike expected for that visit type. The upper respiratory testing self-schedulable visit type was initiated just by a patient clicking a tab in the patient portal which directly led to an appointment template for a swab specimen visit.

Figure 4 Medicare wellness visit shows a jump in activity that occurred when Mayo Clinic sent self-scheduling invitations for this visit type. Figure 4 self-scheduled family medicine periodic exam shows a steady increase consistent with a continued increase in self-scheduling engagement with this visit type.

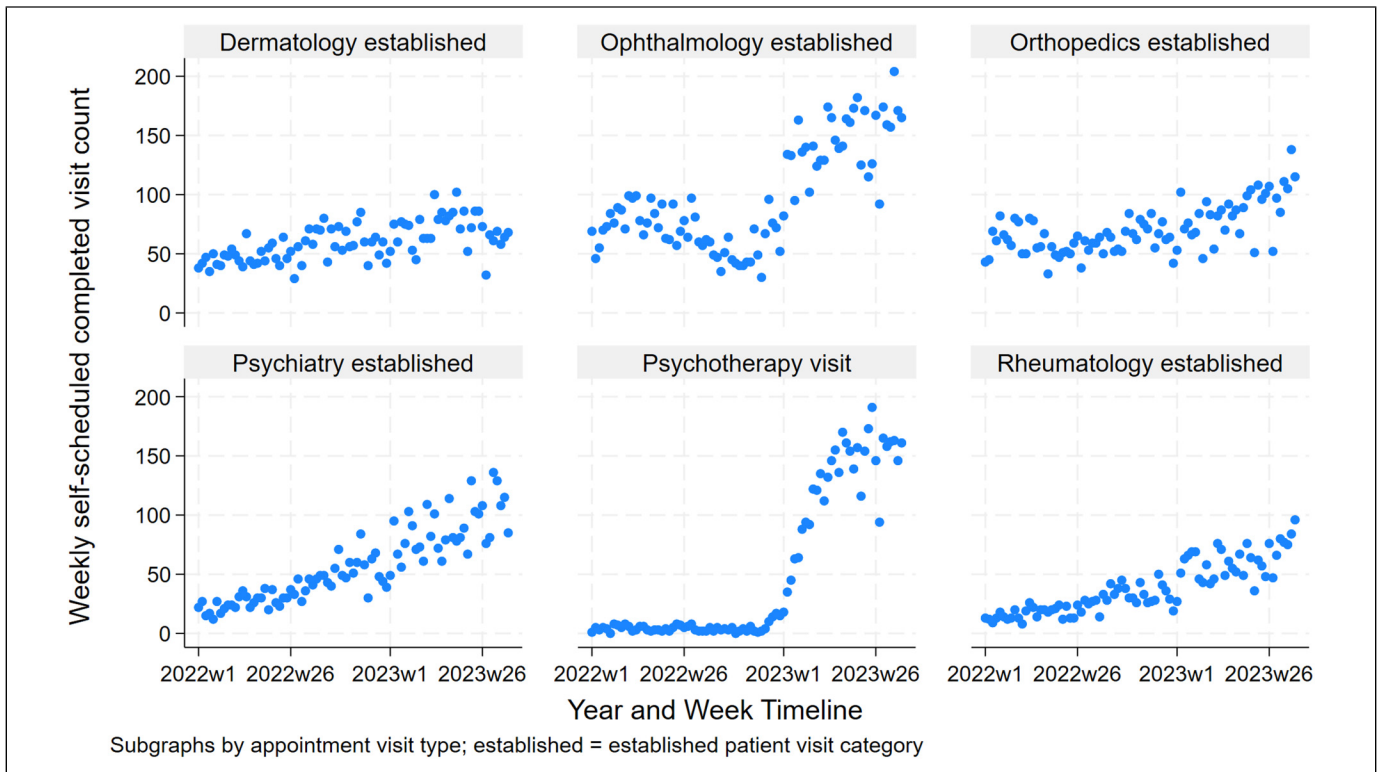
Figure 5 shows self-schedulable visit types that were more recently developed and implemented. These visit types are showing continued growth. The psychotherapy visit type shows a strong increase in self-scheduled visits when it was fully implemented in early 2023. The other 5 subgraphs showed some steady growth over the 85 weeks of the study. The drop in self-scheduled counts for ophthalmology visits is an example of an unusual pattern that may deserve further examination even though the self-scheduled counts recovered and surpassed the previous maximum.

**Self-Scheduled Visits as a Percent of Total Scheduled Visits**

As noted previously, self-scheduled visits increased overall from 3.0% to 5.3% of the total scheduled visits over the 85



**Figure 4.** Scatterplots of weekly self-scheduled completed visit counts for 85 consecutive weeks. Six self-schedulable appointment visit types are shown. Each visit type reached a highest weekly completed self-scheduled visit count of 250 or more but less than 1000.



**Figure 5.** Scatterplots of weekly self-scheduled completed visit counts for 85 consecutive weeks. Six self-schedulable appointment visit types are shown. Each visit type reached a highest weekly completed self-scheduled visit count greater than 95 but less than 250.

weeks in the study. However, individual visit types varied widely in the percent that were self-scheduled. Table 3 shows that for the top 30 ranked self-scheduled visit types, self-scheduling percent of total scheduled ranged from 3% for the orthopedic established patient visit to 92% for the upper respiratory test visit.

The vast majority of visit types that were being self-scheduled already existed as staff-scheduled visit types; self-scheduling was created later as an option to the existing visit type. Some of the range of self-scheduled percentage by visit type is explained by when the self-schedule option was made available. The psychotherapy visit shown in Figure 6 is an example of a more recently self-schedulable visit type. The overall percent psychotherapy visits self-scheduled was 10%. However, at the start of the study, the psychotherapy visit was not being self-scheduled, but in the final weeks of the study it was self-scheduled for 25%. Some visit types were self-schedulable in 2019 and others implemented years later such as the psychotherapy visit type as shown in Figure 6. Many of the 1887 visit types that had been successfully self-scheduled by the end of the 85 week study were not being self-scheduled at the January 1, 2022 start of the study. Differences in overall self-scheduled percent for specific visit types over the 85 weeks are based in part on the staggered dates of implementation.

Figure 6 subgraphs also show visit types that had a staff-scheduling process long before a self-scheduling option was available. The well-child and breast screening visits were the first self-schedulable visits so they have been available to self-schedule since 2019. In Figure 6, breast screening visits seems

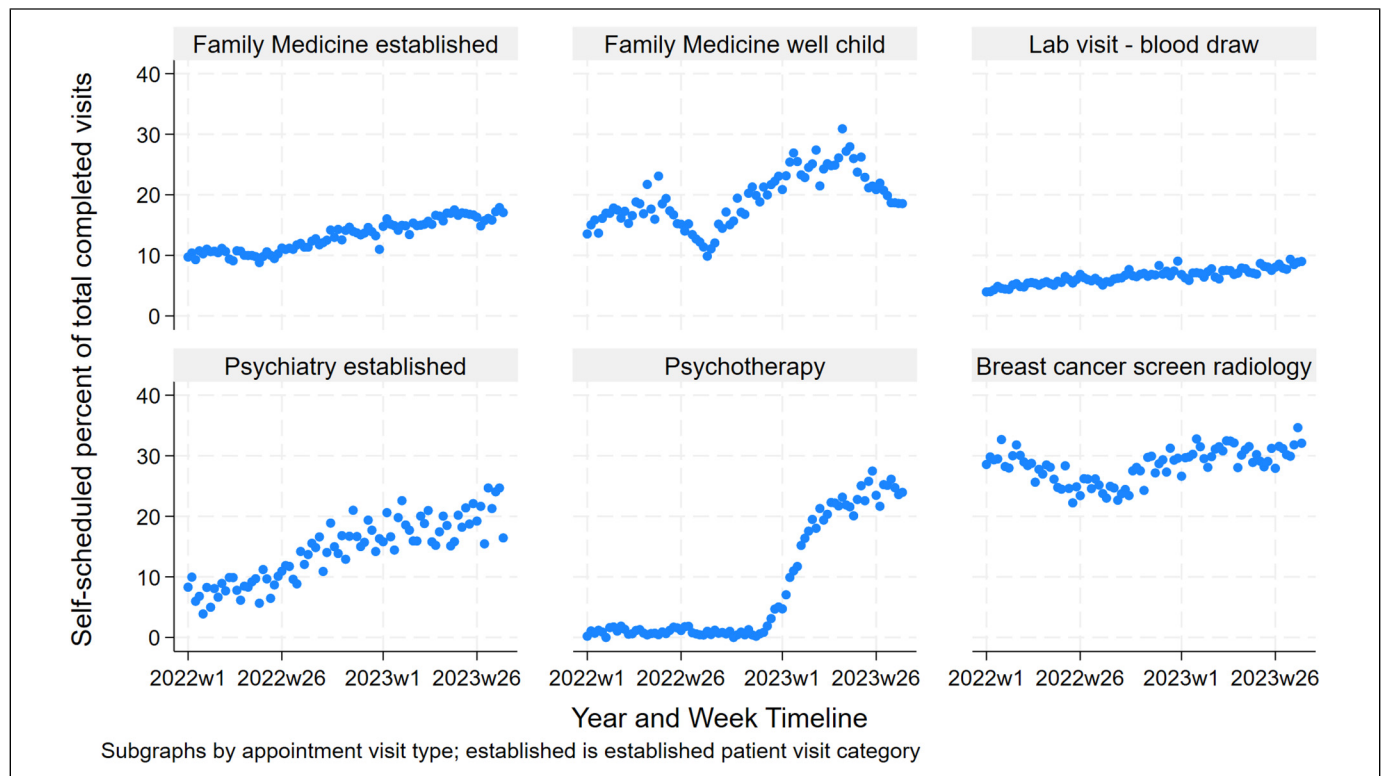
to have leveled off at just over 30% self-scheduled; well-child exams have yet to consistently be 30% self-scheduled. Lab tests and established patient visits in psychiatry and family medicine were made self-schedulable more recently and are showing continued increases in percent self-scheduled but still have not reached 30% of the total visits. The psychotherapy visit became a self-schedulable visit type in 2023; it shows rapid uptake and then levels off at under 30% self-scheduled.

## Discussion

### Principal Findings

Self-scheduled visits as a percent of all completed visits increased from 3.0% to 5.3% over an 85-week period. Self-scheduled visits in 4 visit types accounted for much of the seasonal variability of self-scheduling. After removal of the seasonal visits, there was a nearly linear increase in completed self-scheduled visits over 85 weeks. Laboratory visits accounted for 19.5% of all self-scheduled visits and the combined 4 seasonal visits accounted for 10.6% of all self-scheduled visits. There were 6 different visit types that each had over 1000 self-scheduled visits in at least one week during the 85 weeks; 29 visit types had 100 or more self-scheduled completed visits for at least one week of the 85 weeks.

It is interesting to note the 4 seasonal visits accounting for the peak seen in October, 2022 also corresponded with the



**Figure 6.** Scatterplots of weekly self-scheduled as percent of total scheduled. Subgraphs selected to show variability of percent over time.

availability and rollout of the seasonal influenza vaccine. While this is associated with the increase seen in self-scheduled influenza immunization visits, it also likely increased demand for other vaccinations at the same time (eg COVID and COVID + influenza visits). This illustrates the seasonal volatility of certain self-scheduled visit types which are related to yearly immunizations and seasonal illnesses.

### Practice Implications

Self-scheduled visits have the potential to significantly decrease the work of staff schedulers. Self-scheduling was used to schedule 136 K COVID test visits at Mayo Clinic, saving at least 2900 scheduler hours.<sup>10</sup> Judson et al at University of California San Francisco also found significant time savings with self-scheduling of COVID visits.<sup>9</sup> Our findings show the potential to extend self-scheduling efficiencies well beyond COVID testing.

Our data shows that self-scheduling was successful in thousands of completed immunization visits. Although we did not rigorously evaluate the cost-effectiveness of these self-scheduled seasonal visits, they likely helped the practice with better seasonal load leveling of scheduler time and allowed schedulers to focus their efforts on appointment types requiring more complex scheduling processes.

Lab blood draws were self-scheduled more often than any other self-scheduled appointment type. Unlike Mayo Clinic, many practices do not have scheduled lab appointments and instead use a walk-in process for blood draws and other

specimen collections. However, lab productivity at walk-in labs, when there is a surge of early AM blood tests can be a challenge and can result in longer patient wait times at certain hours.<sup>22</sup> Mayo Clinic has been scheduling lab tests for several years. This is a very high-volume visit type and staff-scheduling comes with a significant cost for scheduler time. Self-scheduling can save scheduler time, thus increasing both lab and scheduling cost-effectiveness.

Commercial medical laboratories are also offering patients the ability to self-schedule lab tests. Labcorp OnDemand™ and Quest Diagnostics® are two examples.<sup>23,24</sup> Quest advertises that you can buy testing for at least 75 lab tests and self-schedule the specimen collection from a choice of 2250 locations.<sup>23</sup> Quest and Labcorp have a wide range of self-schedulable tests including allergy blood tests, comprehensive metabolic panels, lipids, prostate specific antigen (PSA), sexually transmissible disease panels and many others.<sup>23,24</sup> Neither Quest nor Labcorp requires doctor visits for many tests. Medical practices that are not currently scheduling lab tests may want to take note of these commercial labs which are offering patients the convenience and ease of self-scheduling.

Our experience with schedulable immunizations has shown that medical practices can successfully have patients schedule their own vaccine visits. Our data shows that having self-schedulable immunizations and testing can potentially decrease seasonal increases in scheduling activity that could affect other services. Pharmacies such as Walgreens and CVS in the US are also offering self-scheduled immunizations.<sup>25,26</sup> Medical care is

being increasingly delivered outside of the traditional brick and mortar medical practices.<sup>27</sup> It may be important for medical practices to engage established patients by offering the convenience of self-scheduling immunization visits that are now being offered by pharmacies.

Our data also suggest that, for practices that are utilizing self-scheduling, sending out prompts and invitations for patients to schedule services could have the potential to increase uptake of these services. We had a dramatic increase in counts of self-scheduled Medicare Wellness visits in the weeks after portal invitations for this visit were sent to eligible patients (Figure 4).

It is notable that of the top 30 self-scheduled visit types, no consultations or new patient visit types were in this list. These visit types are essential for a multispecialty practice that expects to get new patients and consultations from external and internal referral sources. Although not included in the list of top 30, we have successfully self-scheduled new patient and consultation visit types. These visit types have special challenges that we discuss in another manuscript.<sup>19</sup> In our experience, specialties such as ophthalmology, dermatology and gynecology have had the most uptake in self-schedulable new patient and consultation visits.

### Patient Implications

Patients continue to increasingly engage in self-scheduling. Self-schedulable well-child visit types, which were among the first implemented, continue to show some slight increase in uptake. Figure 6, whose subgraphs show the self-scheduled percent over time for 6 visit types, shows some leveling off of the percentage of screening mammograms that are self-scheduled. Since the 2019 self-scheduling rollout, Mayo Clinic screening mammograms have not consistently been self-scheduled over 35%. Johns Hopkins self-scheduling of screening mammography after 8 years, had risen to 37% of all screening mammograms.<sup>5</sup> At Mayo Clinic, patient registration to Patient Online Services is over 80% so there is a large percent of patients that can take advantage of online scheduling. As with other innovations in healthcare, patient engagement in self-scheduling will need to be examined more closely to determine best practices for “majority adoption” of self-scheduling.<sup>28,29</sup>

Appointments are also self-schedulable on the Mayo Clinic patient mobile app which increases convenience and flexibility for patients to self-schedule, including scheduling outside of the typical business hours of staff schedulers. The Mayo Clinic experience with self-scheduling has found appointments are being self-scheduled at all hours of the day. COVID tests were being self-scheduled between 7 PM and 7 AM 23.6% of the time and mammograms and well child visits were self-scheduled outside of business hours in 24.4% and 29.5% respectively.<sup>6,7,10</sup> The convenience of self-scheduling may continue to drive more engagement in the future.

### Limitations

The self-scheduling processes that generated our data are specific to one multispecialty practice and may not be generalizable to others. In addition, self-scheduling processes are continuing to evolve and

encompass new pathways to allow patients to self-schedule. Self-scheduling processes for different visit types were not all implemented at the same time and we did not adjust our data for the start times when different visit types became self-schedulable.

Our findings are also not generalizable to those for whom English is not a first language. During the study period, the process for patients to self-schedule within the online and mobile app was only available in English. Self-scheduling also requires technology having online or mobile access. Both language and technology barriers can be associated with disparities in access to the self-scheduling process. Health literacy issues may also cause some difficulty with use of self-scheduling. Future research with self-scheduling will need to evaluate how language, technology, and health literacy barriers affect use and outcomes of self-scheduling in diverse patient populations.

There were different visit types for immunizations that were used during the course of the study. Table 3 has 5 unique visit types all with COVID immunization. Some of this was due to the rapid changes in COVID vaccination recommendations. There was also a combination visit type created for patient convenience that scheduled a single appointment for both COVID and influenza vaccinations. This points out the dynamic nature of creating visit types for scheduling and this applies to self-scheduling as well. Other institutions may have had different approaches to the need for dynamic scheduling changes around immunizations and other visit types.

It deserves to be restated that the self-scheduled percents in Table 3, column 4, have a common denominator of total **scheduled** visits. Six visit types in Table 3, identified with a superscript 1, had visits occurring that were not scheduled. Counts of the unscheduled visits were not available for the 6 visit types where this occurred. In those visit types the reader needs to keep in mind that the self-scheduled percent would be lower if we could have used the total of all visits receiving the same service instead of just the total **scheduled** visits for that service.

The longitudinal uptake of any schedulable visit is limited by available slots on schedules. Access to visit types may vary considerably by factors unrelated to the self-scheduling process itself. For example, if there is a supply chain shortage of flu vaccine then all flu immunization visits may have a threshold that limits all scheduling, including self-scheduling.

### Conclusion

Self-scheduled visits are showing a steady increase in a multi-specialty practice. Seasonal self-scheduled immunizations and seasonal self-scheduled visits for respiratory testing show the ability of self-scheduling to help with varying scheduling demands during the year. Self-scheduling has been successful across multiple visit types and is continuing to grow in several different visit categories.








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## Data Availability

Data sharing of additional appointment information is not applicable to this article.

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