The Influence of the Scheduling Horizon on New Patient Arrivals

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Abstract: The goal of scheduling within an ambulatory enterprise is to appropriately accommodate patients; extending capacity to fulfill this aim in a large health care organization requires the management of a complex scheduling process. Understanding and handling the appointment lead time, referred to as the scheduling horizon, can positively influence capacity management. The analysis demonstrated an increased chance of nonarrived appointments of 16% for a specialty practice and 11% for a primary care practice for every 30-day delay in the scheduling horizon. By incorporating the management of the scheduling horizon, health care organizations can optimize the capacity of their ambulatory clinics. **Key words:** *ambulatory, appointment scheduling, capacity management, patient access, patient experience, patient retention, patients, scheduling horizon*

TODAY'S AMBULATORY enterprise must optimize capacity to meet patient demand for clinical services. As value-based care drives the momentum to ensure patients receive treatment in the most appropriate and lowest-cost setting, the goal of optimizing capacity in ambulatory care becomes ever more critical.

The capacity of an ambulatory enterprise is defined by the time its physicians and advanced practice providers have allocated to see and treat patients, with the scheduling template serving as the framework for the delivery of capacity. The Institute of Medicine Committee on Optimizing Scheduling in Health Care (2015) reveals: "Care delivery sites should continuously assess and adjust the match between the demand for services and the organizational tools, personnel, and overall capacity available to meet the demand" (p.88).

Within the scheduling framework for an ambulatory clinic, multiple methodologies are utilized to optimize capacity. Numerous studies have focused on ideal scheduling models (Cayirli et al., 2006; Kaandorp & Koole, 2007; Robinson & Chen, 2003) to expand provider capacity and enhance patient access. Another body of research has focused on furthering patient-provider continuity through appointment scheduling; open access—also known as advanced access—is a method of scheduling in which patients can receive an appointment on the day they request it (Murray & Tantau, 2000). Researchers have

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demonstrated gains in physician, staff, and patient satisfaction, improvement in the ability to match patients with their chosen physician, and reduction in the wait time to an appointment (Murray & Berwick, 2003). Researchers have also analyzed the probability of a patient keeping a scheduled appointment by assessing various demographic and socioeconomic characteristics (Huang & Marcak, 2015; Li et al., 2019; Ruiz-Hernández et al., 2019). These characteristics include, but are not limited to, the patient's insurance coverage, gender, age, and the type of appointment. As Kopach et al. (2007) argue, "In some clinics, no-show rates can be as high as 42% (Lee et al., 2005), introducing enormous volatility in clinic operations and wasting clinical resources. This is not surprising since, during a long appointment lead time, the patient's needs can change significantly" (p.111). Such studies promote changes to the scheduling template to improve alignment of provider supply and patient demand.

This article applies analytics to a single variable: the lead time for the scheduling of the appointment and its impact on patient arrival for appointment. According to Kaplan and Norton (1992) in their treatise about the importance of a business measuring time from their customers' perspectives, "Lead time measures the time required for the company to meet its customers' needs" (p.73). Applying the concept to scheduling an appointment in the ambulatory setting, the appointment lead time is the period between the patient's request for an appointment (when the patient first contacts the practice to request an appointment) and the appointment itself (the date the patient is granted an appointment on the schedule). For purposes of this article, the authors express this appointment lead time as the "scheduling horizon." The goal of the authors is to assess the impact of the scheduling horizon on patients' visit arrivals to determine the relationship between appointment lead times and the probability of patients arriving for their scheduled appointments. Although many characteristics influence the probability of a patient arriving for an appointment, the scheduling horizon is particularly signif-

icant, as it is controllable through capacity management.

METHODS

Health care organizations that are members of the Patient Access Collaborative (PAC) were invited to collaborate on a study to assess scheduling horizons. Representatives from 3 academic health systems, Northwestern Medicine (organization A), Johns Hopkins Medicine (organization B), and The Emory Clinic (organization C), volunteered to participate. Discussions ensued regarding the selection of the ambulatory clinics to be examined across the organizations and the manner of data collection. The focus of this study was determined to be new patients, as the time frame for established patients is often dictated by the treatment plan determined by the physician or advanced practice provider. Transactions that involved new patients scheduling a patient visit were compiled. All reasons for nonarrival were included; these encompass patient no-shows and cancellations initiated by the patient and the respective organizations. Dermatology and General Internal Medicine were selected as the specialties, and de-identified data from appointments scheduled in the ambulatory clinics in calendar years 2017 and 2019 were compiled and submitted to the PAC for analysis. All provider resources were included: physicians and advanced practice providers. No patient-specific information was evaluated. The data represented 187 046 scheduling transactions in General Internal Medicine, which resulted in 115 722 patient arrivals and 71 324 nonarrivals, or 38.1% of patients not arriving for their scheduled appointment. In total, 145 235 scheduling transactions were analyzed for Dermatology, resulting in 87 236 patient arrivals and 57 999 nonarrivals, or 39.9% of patients not arriving for their appointment.

Data collection

Data regarding scheduling transactions were collected from the 3 organizations for new patients who scheduled an appointment

in Dermatology in 2017 and 2019 and General Internal Medicine in 2017 and 2019. The data included the binary outcome of each transaction: patient arrival or patient nonarrival. The lead time between the scheduling of the patients and the outcome of each transaction, referred to as the scheduling horizon, was measured in calendar days. The following values were calculated:

- Total new scheduled appointments;
- Total nonarrived appointments;
- Nonarrival rates (nonarrivals divided by total scheduled appointments); and
- Relative risk (RR) of nonarrived appointments.

Statistical analysis

In a first analysis, the scheduling horizon was categorized into specific time segments from the date the patient scheduled an appointment to the date the patient was given an appointment. The appointment lead time was identified as same-day appointment, next-day appointment, and appointment within 2 to 14 days, 15 to 30 days, 31 to 90 days, and more than 91 days. The number of nonarrived patients for each of the time segments was then determined. A trend-in-proportion χ^2 test was conducted to determine whether there was a statistically significant trend of nonarrived appointments by scheduling horizon. This analysis was repeated for Dermatology and General Internal Medicine, for each organization, and for all 3 organizations combined.

Next, the scheduling horizon was entered as a continuous variable in a log-binomial regression model to calculate the RR of patient nonarrivals for every 30-day delay. Additional models were fit that adjusted for appointment month. Poisson regression with robust estimation of the variance was used to estimate RR when the log-binomial model failed to converge. All analyses were conducted using the R statistical software package version 3.5.3 (R Core Team, 2019).

RESULTS

The study included a total of 145 235 patients in Dermatology: 53 301 from organiza-

tion A; 62 648 from organization B; and 29 286 from organization C. Each organization experienced an increase in nonarrivals as the scheduling horizon lengthened (Table 1). At 90 days, the percentage of nonarrivals (58.8%) surpassed the percentage of arrivals (41.2%) for each organization. Overall, 39.9% of patients with scheduled appointments in Dermatology did not arrive, ranging from 36.5% for organization A, 40.7% for organization B, and 44.5% for organization C.

For General Internal Medicine, the study included a total of 187 046 patients: 101 558 from organization A; 53 237 from organization B; and 32 251 from organization C. Each organization experienced an increase in nonarrivals as the scheduling horizon lengthened (Table 2). At 90 days, the percentage of nonarrivals (56.8%) surpassed the percentage of arrivals (43.2%) for each organization. Overall, 38.1% of patients with scheduled appointments in General Internal Medicine did not arrive, ranging from 36.4% for organization A, 39.1% for organization B, and 42.0% for organization C.

All 3 organizations experienced a change in nonarrivals based on the scheduling horizon. For Dermatology, there was a 16% (95% confidence interval, 15-16; $P < .0001$) increased chance of nonarrived appointments for every 30-day delay in the scheduling horizon. For General Internal Medicine, there was a 11% (95% confidence interval, 11-12; $P < .0001$) increased change of nonarrived appointments for every 30-day delay in the scheduling horizon. This association was consistent when the analysis was repeated for each organization separately and after adjusting for appointment month (Table 3).

The analysis revealed a significant decline in the RR for each organization between 2017 and 2019, except for General Internal Medicine in organization B. During the period of 2017-2019, all 3 organizations made efforts to reduce nonarrivals by addressing external and internal factors. These include improved frequency and delivery methods of appointment reminders, stricter rules regarding patient cancellations and no-shows, increased internal education and data regarding

Table 1. Nonarrived Appointment Proportion by Scheduling Horizon Category in the 3 Organizations and Trend-in-Proportion Testing for Dermatology (2017 and 2019)

Delay	Sum			Organization A			Organization B			Organization C		
	Total, N	Non-arrived, n	Non-arrived, %	Total, N	Non-arrived, n	Non-arrived, %	Total, N	Non-arrived, n	Non-arrived, %	Total, N	Non-arrived, n	Non-arrived, %
Same day	5 549	725	13.1	1 890	242	12.8	2 670	321	12	989	162	16.4
Next day	8 701	1 651	19	3 175	593	18.7	3 723	691	18.6	1 803	367	20.4
2-14 d	38 555	11 177	29	15 729	4 472	28.4	14 930	4 140	27.7	7 896	2 565	32.5
15-30 d	20 850	8 041	38.6	8 647	3 290	38	7 814	2 896	37.1	4 389	1 855	42.3
31-90 d	50 704	24 134	47.6	20 421	9 113	44.6	21 102	10 122	48	9 181	4 899	53.4
91+ d	20 876	12 271	58.8	3 439	1 755	51	12 409	7 330	59.1	5 028	3 186	63.4
P-trend[a]		<.0001			<.0001			<.0001			<.0001	
Overall	145 235	57 999	39.9	53 301	19 465	36.5	62 648	25 500	40.7	29 286	13 034	44.5

[a]P value from the trend-in-proportion χ^2 test.

Table 2. Nonarrived Appointment Proportion by Scheduling Horizon Category in the 3 Organizations and Trend-in-Proportion Testing for General Internal Medicine (2017 and 2019)

Delay	Sum			Organization A			Organization B			Organization C		
	Total, N	Non-arrived, n	Non-arrived, %	Total, N	Non-arrived, n	Non-arrived, %	Total, N	Non-arrived, n	Non-arrived, %	Total, N	Non-arrived, n	Non-arrived, %
Same day	7 664	1 033	13.5	4 319	503	11.6	2 517	365	14.5	828	165	19.9
Next day	8 562	1 930	22.5	4 537	1 008	22.2	2 488	541	21.7	1 537	381	24.8
2-14 d	70 943	24 332	34.3	40 398	13 949	34.5	15 195	4 820	31.7	15 350	5 563	36.2
15-30 d	39 326	15 283	38.9	25 431	9 881	38.9	10 777	4 150	38.5	3 118	1 252	40.2
31-90 d	44 191	19 453	44.0	21 164	8 675	41	15 731	7 213	45.9	7 296	3 565	48.9
91+ d	16 360	9 293	56.8	5 709	2 941	51.5	6 529	3 744	57.3	4 122	2 608	63.3
P-trend[a]		<.0001			<.0001			<.0001			<.0001	
Overall	187 046	71 324	38.1	101 558	36 957	36.4	53 237	20 833	39.1	32 251	13 534	42.0

[a]P value from the trend-in-proportion χ^2 test.

Table 3. Relative Risk of Nonarrived Appointments for Every 30-Day Delay in the Scheduling Horizon for Dermatology and General Internal Medicine (2017 and 2019)

	Year	Dermatology				General Internal Medicine			
		Model 1[a]		Model 2[a]		Model 1[a]		Model 2[a]	
		RR (95% CI)	P	RR (95% CI)	P	RR (95% CI)	P	RR (95% CI)	P
Organization A	2017	1.15 (1.13-1.17)	<.0001	1.15 (1.13-1.17)	<.0001	1.10 (1.10-1.11)	<.0001	1.10 (1.10-1.11)	<.0001
	2019	1.13 (1.12-1.13)	<.0001	1.13 (1.12-1.13)	<.0001	1.08 (1.08-1.08)	<.0001	1.08 (1.08-1.08)	<.0001
Organization B	2017	1.22 (1.20-1.23)	<.0001	1.22 (1.20-1.23)	<.0001	1.11 (1.10-1.12)	<.0001	1.11 (1.10-1.12)	<.0001
	2019	1.15 (1.15-1.16)	<.0001	1.15 (1.15-1.16)	<.0001	1.11 (1.11-1.12)	<.0001	1.11 (1.11-1.12)	<.0001
Organization C	2017	1.21 (1.19-1.23)	<.0001	1.21 (1.19-1.23)	<.0001	1.07 (1.07-1.07)	<.0001	1.07 (1.07-1.07)	<.0001
	2019	1.16 (1.15-1.17)	<.0001	1.16 (1.15-1.17)	<.0001	1.05 (1.05-1.05)	<.0001	1.05 (1.05-1.05)	<.0001
All 3 organizations		1.16[b] (1.15-1.16)	<.0001	1.16 (1.15-1.16)	<.0001	1.11[c] (1.11-1.12)	<.0001	1.11 (1.11-1.12)	<.0001

Abbreviations: CI, confidence interval; RR, relative risk.

[a]Model 1 is unadjusted. Model 2 is adjusted for month of appointment modeled as a categorical variable.

[b]RR of 1.16 can be interpreted as there is 16% increased chance of a nonarrived appointment for every 30-day delay in the scheduling horizon.

[c]RR of 1.11 can be interpreted as there is 11% increased chance of a nonarrived appointment for every 30-day delay in the scheduling horizon.

patient access in ambulatory clinics, and enhanced awareness regarding internal changes to schedules that result in patients being bumped from their original appointment slot.

DISCUSSION

Identifying opportunities to prevent nonarrivals provides value to patients and health care organizations. The appointment lead time impacts patients' ability or willingness to keep their appointments. Health care organizations expend precious resources in ambulatory clinics. When patients do not arrive, remuneration cannot be sought in a fee-for-service environment as no visit has taken place. This occurs even though the organization expended resources in the scheduling and visit preparation processes to accommodate that patient.

If patients do not maintain their scheduled appointments, clinical care may not be provided in a timely manner, time allocated on the schedule for the patient is wasted, and the health care organization may have lost the patient to another organization. The opportunity cost associated with the nonarrival translates into a loss for the community, as the provider's time may not be reallocated to another patient in need of care.

Scheduling may also be impacted by the organization itself. This may be a result of a change in a provider's calendar, appointment template, room availability, and staff resources. The likelihood for these logistical disruptions increases with time.

Improvement opportunities can be identified by measuring appointment lead time for new patients, benchmarking this rate to other practices, and taking active steps to reduce lead time in order to improve patient arrival rates. The PAC, which represents 90 academic health systems and children's hospitals, surveys its members each year regarding new patient lead time in ambulatory clinics. The median new patient lead time for the most current reporting year (2019) is 21.5 days. The median nonarrival rate for all PAC members is 36.4%, slightly lower than that which this research study found yet demonstrating the industry-wide opportunity should this rate be improved. Health care organizations can understand their own data regarding new patient scheduling in the ambulatory enterprise and compare against national benchmarks to identify the magnitude of opportunity to improve arrival rates.

Actionable changes may be made within the health care organization to reduce lead time and improve patient arrivals. For example, employees tasked with the role of scheduling new patients may be provided instructions to locate an available time on an electronic calendar displayed on their computer. Health care organizations can take strides to ensure that the date and time being offered prioritize the appointments available in the shortest time frame. Offering open appointments can be managed by tools and training provided to employees, as well as the construction of online, self-service appointment systems that increase patients' access to scheduling a timely appointment.

In addition, offering open slots in a time frame that will positively impact the arrival rate can be enhanced by ensuring that appointment confirmations are communicated to patients in a timely and effective manner. Health care organizations can prompt patients' consideration of keeping their appointments via multiple communications depending on the lead time segment. For example, based on this study, consideration can be given to communicating with patients who schedule their appointment more than 90 days out, as this patient cohort has a high rate of patients failing to attend their appointment. Appointment confirmations for this cohort of patients can be generated several weeks in advance of the appointment and continuing up to the day of the patient's appointment to trigger patients to arrive, as well as to permit patients to inform the organization if they intend to cancel, reschedule, or otherwise not arrive for their appointment.

If the patient cancels the appointment, the request to cancel can be processed in a timely manner. This can be facilitated by allowing patients to cancel themselves any time, any day, for example, through an online, self-service

appointment system. Whether manually performed by the health care organization or captured by an online, self-service appointment system, the newly opened slot could then be automatically made available, allowing the previously reserved slot to immediately revert to an open slot available for scheduling.

Health care organizations can also analyze provider appointment templates to ensure that all available time is offered for scheduling. This can include a daily review of the following day, and subsequent week, to identify open, unscheduled appointment slots. The slots can be reviewed for restrictions that may have been placed on them to "hold" or "block" the time to determine whether the constraint is warranted. Differences in scheduling processes can also be explored to include the type of scheduling methodology that is utilized. For example, a fixed schedule that allocates visit slots by day and time for a specific type of patient versus an open schedule that permits patients to be more fluidly scheduled. All these strategies allow organizations to control their own scheduling horizon, thereby influencing the probability of patients' arrival.

By evaluating the nonarrivals that result from the organization, internal stakeholders may address administrative processes related to documenting calendar changes for providers in a timely, precise manner. If providers and administrators are aware of the effects of changes to templates, rooms, and staff resources, efforts can be made to alleviate the impact by proactively arranging for these changes to be made in advance of the scheduling disruption. Recognition of the nonarrivals that result from each time period may offer guardrails for policies and procedures related to these administrative matters.

On a macro level, the authors surmise that differences in the number of patients seeking care and providers available to schedule affect the scheduling horizon. In addition to internal factors, the tolerance of patients, as consumers of health care, for the time to receive a new patient appointment may influence the horizon. Consumer tolerance is dependent on the severity of illness, the availability of the specialty in the patient's market, the diagno-sis and/or the accessibility of treatment options. Health care organizations can increase their awareness of consumer expectations, as well as the availability of each specialty in their market. This recognition can lead the organization to increase capacity if needed by recruiting physicians and advanced practice providers or otherwise altering their schedules to expand patient access opportunities.

LIMITATIONS

The research focused on only 3 organizations, and each of the organizations is an academic health system. The research included only 2 specialties. The research did not incorporate the *reason* for nonarrival, only the fact that the patient had not arrived. This research focused exclusively on time; the impact of variables such as the patient's insurance coverage, gender, and age; the type of appointment; the patient's medical condition; the method, timing, frequency, and content of appointment confirmation; and the penalties associated with the failure to show without notification were not assessed. The study analyzed data at the time of the scheduling transaction; this may or may not be reflective of the perspective of the patient or a referring provider as there may have been a gap between the request and the request being fulfilled in the form of receiving an appointment. The research did not account for the provider type—physician versus advanced practice provider. Furthermore, the study did not measure outcomes regarding patient experience or clinical quality. Additional research regarding these variables is recommended for further investigation.

CONCLUSION

Evaluating patient arrival rates presents a significant opportunity for health care organizations to optimize capacity to meet patient demand for clinical services. The value proposition of analyzing and managing the scheduling horizon in the ambulatory enterprise guides informed decisions in scheduling practices to reduce the burden of patient nonarrivals.

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