A Web-based Generalist–Specialist System to Improve Scheduling of Outpatient Specialty Consultations in an Academic Center

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BACKGROUND: Failed referrals for specialty care are common and often represent medical errors. Technological structures and processes account for many failures. Scheduling appointments for subspecialty evaluation is a first step in outpatient referral and consultation.

OBJECTIVE: We determined whether moving from paper-based referrals to a Web-based system with automated tracking features was associated with greater scheduling of appointments among referred patients.

DESIGN: Staggered implementation of a quality-improvement project, with comparison of intervention and control groups.

PARTICIPANTS: Patients 21 or more years of age referred from any of 11 primary-care clinics to any of 25 specialty clinics.

INTERVENTIONS: Faxed referrals were replaced by a Web-based application shared by generalists and specialists, with enhanced communications and automated notification to the specialty office.

MEASUREMENTS: We compared scheduling before and after implementation and time from referral to appointment. A logistic regression analysis adjusted for demographics.

MAIN RESULTS: Among 40,487 referrals, 54% led to scheduled specialty visits before intervention, compared to 83% with intervention. The median time to appointment was 168 days without intervention and 78 days with intervention. Scheduling increased more when duplicate referrals were not generated (54% for single orders, 24% for multiple orders). After adjustment, referrals with the intervention were more than twice as likely to have scheduled visits.

CONCLUSIONS: With a new Web-based referrals system, referrals were more than twice as likely to lead to a

scheduled visit. This system improves access to specialty medical services.

KEY WORDS: referral and consultation; ambulatory care; information systems.

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INTRODUCTION

As medicine undergoes organizational changes, the relationships, interfaces, and flow of patients between primary-care and subspecialists are becoming more complex¹. Up to 20% of general medical patients are referred to specialists^{2,3}, and many referrals are inappropriate, are never completed, or lead to unintended events⁴. Failure to complete a requested consultation is a serious problem, with about half of consultants' recommendations going uncompleted^{5–8}. Failures of scheduling outpatient specialty consultation can especially be caused by technological structures or processes, such as lost, duplicated, incomplete, or mishandled papers, facsimiles, or other communications. One study of coordination of referrals and physician satisfaction showed that information was sent to specialists in only about half of referrals⁹. When routine scheduling of outpatient consultation fails, even for technical reasons, the consultant has no opportunity to evaluate the patient as planned, and quality of care is thus diminished. Such failures represent medical errors, "failure of a planned action to be completed as intended or use of a wrong plan to achieve an aim"¹⁰.

With gradually increasing adoption of electronic medical record systems, electronic referral systems have emerged as strategic networks for communication between sites of primary and secondary care, and with them comes the potential to improve access to care, continuity of care, and clinical management¹¹. To increase the fraction of consultation orders leading to appointments, we designed a Web-based collaborative generalist-specialist system in an academic medical center. The system stores and tracks information about referrals, allows generalists and specialists to access the system, and provides notifications or reminders to both ends when follow-up or intervention is needed. We hypothesized

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that this system would increase, by at least 50%, the fraction of referrals leading to a scheduled visit for consultation.

METHODS

Setting. The home institution provides a tax-supported, urban healthcare system providing outpatient, inpatient, and community-based health services to residents of a Midwestern county in the U.S. The hospital and a core of outpatient clinics are located on the campus of an academic medical center. Additional community health centers providing primary care are located around the metropolitan area. In 2006, the institution serviced 1,166,988 outpatient visits, including 194,546 visits to community health centers. The payer mix is 28% Medicaid, 21% Medicare, 9.5% commercial, and 36% uninsured. A special program of services is provided for many low-income patients who are not eligible for Medicaid benefits. The institution has more than 1,000 physicians on its medical staff. Adult patients receiving primary care at the institution tend to receive all major medical care within the system, and most referrals for patients originate within the system and target specialty clinics or sites that are also in the system. All scheduling of routine and urgent visits is ultimately recorded in an electronic registration and scheduling system. The registration system also electronically stores contact information about patients, including gender, race, and date of birth.

Usual Care. Under usual care, primary-care physicians requested consultation by creating an order in the electronic medical records system. This was reviewed by primary-care office personnel, who printed and faxed the order to the specialty office, where it was reviewed again for completeness and appropriateness. The specialty office personnel could then schedule an appointment for consultation, or deny the request and return it to the primary-care office. Requests for consultation are sometimes denied if clinical or demographic information is missing or if the patient's condition does not meet inclusion or exclusion criteria specified by policies of the institution or consulting service.

To schedule an appointment with the patient, the specialty clinic would attempt to contact the patient by telephone, up to three times. Patients who could not be reached would be mailed an appointment card. Once this was complete, the referral was closed. The specialty care physicians would review cases when patients failed to appear for appointments, to determine whether the patients needed to be seen immediately or could wait for the next available appointment. The patient would be called by telephone; the referral coordinator would then reschedule the visit. Patients who failed to show three times were required to see their primary-care provider to obtain a new referral.

Intervention. To evaluate and improve the process and outcomes of referrals and consultations, a team of generalists and specialists met for one hour every two weeks, using a plan-do-study-act approach to quality improvement. The team, representing medicine, nursing, administration, informatics, and research, examined barriers to completion of scheduling and devised a new approach. Under the new methods developed, primary-care office personnel recorded clinicians' requests for

consultation electronically, via a new Web-based interface. Faxing was replaced by encrypted, Internet-based delivery of requests to specialty offices, and all incidents of non-scheduling, whether intended or unintended, led to delivery of electronic mail to referring office staff. Unintended non-scheduling—that is, requests not receiving attention from specialty office personnel within 48 hours for an urgent request, seven days for a semi-urgent request, or fourteen days for a routine request—also led to automated reminders being sent to the specialty office personnel, including supervisors. Data were stored on a secure server. The intervention was dubbed “Referral Order Management Portal” (ROMP). ROMP was driven by a Web-based application adapted from commercial software¹² used to support a help desk for technical support in the institution. A summary of key features is provided in Table 1. Since the original vendor of the help-desk software performed the core modifications to create ROMP, the local institution does not own the application and is not licensed to distribute it.

Study Design and Implementation. This study emerged from a quality-improvement project. Following implementation at the on-campus primary-care clinic, we used computer-generated, randomly ordered staggering of the implementation at all ten remaining referring primary-care sites (community health centers) and 25 specialty consulting sites or clinics. This allowed a small team of implementers to introduce the system at each site and provide proper training, while allowing the investigators to assess referrals and scheduling before (control) and after (intervention) implementation at each site. These sites, before or after intervention, were used for the main analysis. Ten additional consulting sites without ROMP served as an additional comparison group. Throughout 2005, we activated the intervention at the 11 referring and 25 consulting sites, one at a time. Since, through this staggered implementation, a referring site with access to the intervention could use usual care to refer to consulting sites without the intervention, ROMP was programmed to accept referrals only from authorized referring sites and only to authorized consulting sites. Specialty clinic staff using ROMP were also instructed to return to the referring site any referral made through usual care, for referring sites with access to ROMP. Eligible patients were all patients 21 or more years of age referred from a primary-care clinic to a specialty clinic. Eligible

Table 1. Characteristics of Referral Before and After Intervention

Characteristic	Electronic referral before intervention	Electronic referral after intervention
Providers enter referral information into electronic form	Yes	Yes
Staff in consulting clinics rely on stacks of faxes to identify new referrals	Yes	No
Staff can quickly identify and review all unscheduled referrals	No	Yes
Staff in referring and consulting clinics see same information and use common interface to communicate electronically	No	Yes
Staff automatically receive notifications about referrals that remain unscheduled	No	Yes
Staff supervisors receive additional notifications about prolonged delays	No	Yes
Audit trail is created and can be reviewed	No	Yes

physicians were all referring and consulting physicians who generated a referral or evaluated at least one participating patient at a participating site.

Analysis. For analysis, data from the electronic registration and scheduling system were extracted. Clinics in the main analysis—the 11 referring and 25 consulting sites—served as control sites before receiving the intervention and served as intervention sites after receiving the intervention. In other words, the control clinics

were the actual intervention clinics when they still used a faxed referral before the intervention was in place. An observation was coded as interventional when both referring and consulting sites had access to the intervention. An observation was pre-interventional when the referring or consulting site did not have access. To provide additional control data, we included six months of referrals data before the intervention was ever implemented. During these six months, all clinics and referrals were categorized as controls.

Table 2. Referrals and Specialty Appointments, by Patients' Characteristics and Clinical Sites

Characteristic	Before intervention		After intervention		Relative Change in Scheduling (%)
	Referral orders, n*	Scheduled appointments (%)	Referral orders, n*	Scheduled appointments (%)	
Gender					
Female	12421	54	14593	83	54
Male	6016	55	7454	83	51
Race					
White	8293	54	9368	83	54
Black	8060	56	9985	84	50
Hispanic	1309	57	1894	84	47
Other	379	47	488	82	74
Age (years)					
21–39	3748	55	4594	84	53
40–49	5000	52	6053	82	58
50–64	6260	54	7384	83	54
65 or more	3430	57	4018	84	47
Multiple orders					
No	16863	54	20823	83	54
Yes	1575	62	1226	77	24
Referring site	18436	54	22049	83	54
A	6324	50	9041	82	64
B	2926	57	2826	83	46
C	1980	54	2192	82	52
D	1972	41	1229	70	71
E	1608	60	1702	87	45
F	1551	61	1638	87	43
G	535	62	1288	91	47
H	502	62	629	83	34
I	476	63	420	89	41
J	383	74	959	83	12
K	179	67	125	86	28
Specialty site					
Allergy	109	42	155	87	107
Breast health	88	52	51	77	48
Breast oncology	19	37	31	52	41
Cardiology	531	57	803	84	47
Continence	239	49	168	40	–18
Dermatology	1562	55	1812	94	71
Endocrinology	317	56	463	88	57
Gastroenterology	709	60	1000	91	52
Hematology	99	55	164	88	60
Infectious Diseases	55	60	98	91	52
Nephrology	257	56	387	91	63
Neurology	1061	58	1096	83	43
Neurosurgery	465	62	622	78	26
Obstetrics/Gynecology	1665	55	2046	86	56
Oncology	62	48	87	70	46
Ophthalmology	4956	54	5740	80	48
Orthopedics	1353	48	1703	81	69
Otolaryngology	1004	56	1158	91	63
Podiatry	1281	55	1726	85	55
Pulmonary	412	39	506	65	67
Rehabilitation	110	27	177	32	19
Rheumatology	334	54	419	84	56
Surgery	780	61	837	85	39
Urology	796	59	625	85	44
Vascular surgery	174	38	175	80	111

*Totals among characteristics vary due to missing data

For specialty clinics not in the main analysis—the 10 additional consulting sites without ROMP—an observation was called “pre-interventional” if a referral was ordered prior to the last date on which the intervention was implemented for clinics in the main analysis. We assessed whether referrals led to scheduling of specialty appointments corresponding to the referrals. Scheduled appointments were defined as appointments that matched the referral, such as cardiology appointment following a cardiology referral, and were scheduled to occur within 180 days of the matching referral.

Because improperly generated referrals or referrals to especially busy specialty clinics may have been generated multiple times before scheduling occurred, we included an assessment of whether a referral was a first, or duplicate, referral to a specialty. Referrals with duplicates may be associated with different levels of scheduling than referrals without duplicates. If an order were repeated for a patient over time, we created a variable that documented the number of repeated orders.

We compared intervention and control groups using chi-square testing. To determine the independent relationship between the intervention and scheduling of the specialty appointment, we conducted logistic regression, adjusting for demographics and the strata consisting of combinations of referring and specialty sites. P-value significance threshold was 0.05 for statistical analyses.

The analysis described above is based on the stepwise implementation of the intervention over several months. Unmeasured, time-related factors may have played a role or affected the results. Therefore, to test a narrower study interval, we conducted an additional logistic regression analysis without the initial six months of control data. As in the main analysis, controls represented referrals before the intervention was available at both referring and consulting sites. We also manually examined a sample of denied referrals, to compile information about why the referrals were denied. The study was approved by the Institutional Review Board.

RESULTS

We identified 56,549 referrals among 26,456 patients. The mean age among patients was 49 years; 15% were 65 or more

years of age, 67% were women, 44% were African-American, 43% were white, and 11% were Hispanic. The main analysis comprised 40,487 referrals (Table 2). Among these, 54% led to scheduled specialty visits before ROMP, compared to 83% with ROMP. The median time to appointment was 168 days without ROMP and 78 days with ROMP. More variation was found among clinical sites than among gender, race, and age. Scheduling increased more when duplicate orders for referral were not required (54% for single orders vs. 24% for multiple orders).

Odds ratios from logistic regression models are presented in Table 3. In the models shown, each referring-specialty site combination (11×25) is treated as a separate stratum, resulting in 270 strata; five referral-specialty combinations had no observations. After adjustment, referrals with ROMP were 4.3 times more likely to have a scheduled visit than those without. Also independently statistically significant were single orders and age, with older patients seeing slightly more scheduling. When the interval was narrowed by excluding the initial six months of control data, the odds ratio decreased to 2.8 but remained statistically significant (N=11,998 referrals).

Scheduling of appointments among non-ROMP specialties outside the main analysis are shown in Table 4. Approximately 34% of pre-ROMP referrals had scheduled appointments, compared to 33% after ROMP was fully implemented for clinics in the main analysis. Logistic regression comparing the two periods revealed an odds ratio of 0.97 (p=0.324). Using a logistic regression model adjusting for the same factors as in Table 3, the odds ratio decreased to 0.92 (p=0.020).

Five percent of referrals were denied. Table 5 shows reasons for denial, among a sample of 1,255 denied referrals. Among these, duplicate orders occurred in 26%, patients did not meet clinical criteria in 26%, and the incorrect clinical site was targeted in 20%.

DISCUSSION

Specialty medical care is vital for our primary-care patients and, except for self-referrals, outpatient specialty care does not typically occur unless referrals are processed and completed without error. Although lack of timeliness is a major problem with current referral systems¹³, and delays in completion of

Table 3. Logistic Regression Results for Scheduling of Specialty Appointments, Stratified by Referring Site and Specialty

Characteristic	Including six months of control data before any intervention (N=40,487)			Excluding first six months of control data (N=11,998)		
	Odds ratio	95% confidence interval	P-value	Odds ratio	95% confidence interval	P-value
Intervention	4.32	(4.12, 4.54)	<0.001	2.75	(2.44, 3.10)	<0.001
Gender, male	1.00	(0.95, 1.06)	0.940	0.94	(0.84, 1.05)	0.261
Race			0.241			0.218
White*	1.00			1.00		
Black	0.99	(0.94, 1.05)		1.07	(0.95, 1.20)	
Hispanic	0.99	(0.90, 1.09)		0.91	(0.74, 1.12)	
Other	0.85	(0.72, 1.00)		0.83	(0.60, 1.14)	
Age			0.008			0.622
21–39	0.92	(0.85, 1.00)		1.04	(0.88, 1.23)	
40–49	0.88	(0.81, 0.95)		1.11	(0.95, 1.29)	
50–64	0.94	(0.87, 1.00)		1.05	(0.91, 1.22)	
65 or more*	1.00			1.00		
Single order	0.85	(0.78, 0.93)	<0.001	0.86	(0.74, 1.08)	0.250

*Reference value

Table 4. Referrals and Appointments, by Specialty, for Specialty Sites not in the Main Analysis

Specialty	Before intervention		After intervention		Change in scheduling (%)
	Referral orders	Scheduled appointments (%)	Referral orders	Scheduled appointments (%)	
Specialty site	9524	34	6538	33	-2.9
Anticoagulation	87	76	61	82	7.9
Burn	0	0	4	50	
Dental	586	15	414	14	-6.7
Geriatrics	118	59	113	54	-8.5
Nutrition	2764	50	1876	46	-8.0
Occupational therapy	332	11	187	19	73
Physical therapy	3557	21	2478	29	38
Plastic Surgery	152	63	113	66	4.8
Psychiatry	1245	25	857	24	-4.0
Trauma	4	100	0	0	-100

consultation are associated with adverse clinical outcomes¹⁴, hardly any studies have systematically evaluated the impact of scheduling systems on outcomes in a healthcare setting. In this study, we designed and implemented a Web-based system, shared by generalists and specialists, for scheduling outpatient consultation. Independent of other measured factors, including temporal changes in referrals, the referrals with ROMP were at least twice as likely to have a scheduled visit, compared to those without ROMP. Without a systematic, partly automated approach, the referrals, which often occur via fax, can be lost through mishandling or even just fax machines that run out of paper. Furthermore, such errors can be difficult to track or even identify quickly. Our system improves care by adding a shared information and communications system as well as automated alerts about referrals that have not been addressed promptly.

Better coordination of referral could improve efficiency, costs, and quality of care. Various approaches have been taken to address the problems of referral. The Department of Veterans Affairs initiated a Quality Improvement Technical Assistance Project specifically to address the completion of consultations¹⁵. Some have reported electronic messaging systems between primary and secondary care¹⁶. The Walter Reed Army Medical Center implemented an "Ask a Doc" referral system based on electronic mail, with an average response time to consultation of less than one day¹⁷. Additional work in this field could determine which features of such systems are most important and whether combining features improves outcomes.

Benefits of a computer-based referrals system, such as described here, could well be seen in other settings. The local system used the Web and a standard Web browser, without directly requiring an electronic medical records system. The system created the methods and capacity to record and deliver clinical history and the reason for the referral. Although we did not study and report about usability, we observed that the system

was highly usable and valued by both staff and providers. It fit well into workflow, since referrals staff had desktop computers and could spend blocks of time using the computer interface to process referrals in batches. The time required to process a referral was not measured but was estimated to have decreased, due to the way the intervention eliminated problems with lost faxes and needs to interrupt workflow with duplicate fax transmissions and telephone calls to track paperwork. A more detailed assessment of usability would require further study.

With attention to design, systems of this type could more effectively address common reasons for denied referrals, such as duplicates, inadequate clinical criteria, or an incorrectly targeted clinic site. This can ultimately reduce waiting times and efficiency or accuracy of billing¹⁸. One radiology study comparing online scheduling to traditional telephone-based scheduling showed that 78% of physicians felt ready for online scheduling, and 75% of physicians who tried the system stated that it was easier to schedule patient online¹⁹. Another radiology study showed that patients' waiting times decreased from two or three weeks for telephone-based scheduling, to two or three days for electronic scheduling²⁰.

In the analysis with the longer interval, single orders and older ages were independently more likely to lead to scheduled visits. Coordinating referrals for patients who are hospitalized, institutionalized elsewhere, or require frequent medical care may be difficult and require multiple referrals, and this may explain the lower scheduling rates for those with multiple referral orders. With the methods of this study, we cannot ascertain why older patients were somewhat more likely to have scheduled appointments. Their greater comorbidity may translate to more urgent clinical needs, or their insurance coverage—more universal with Medicare—may have played a role.

Some referrals did not seem to benefit from the intervention. Referrals for continence or rehabilitation saw a decrease or only a modest increase in scheduling. Although we did not investigate these specific cases, we suspect special circumstances unrelated to the intervention but that could not be overcome by the intervention. The intervention, for example, cannot address the problems of full clinics or other backlogs or idiosyncrasies in the workflow of processing referrals. The intervention seemed to address only the most common causes of lost or delayed referrals.

The study has limitations. Since staff at consulting sites managed both faxed and Web-based referrals, contamination may have occurred if experience with the intervention led to closer follow-up of controls, but this would provide us with a

Table 5. Reasons for 1,255 Denied Referrals

Reason for denied referral	Percentage of denied referrals
Duplicate order	26
Patient did not meet clinical criteria	26
Incorrect clinical site was targeted	20
Insurance	15
Patient refused appointment	3
Missing administrative or clinical information	2
Other	8

conservative estimate of the intervention's effect. This analysis also did not examine kept visits, which would ultimately be important in assessing completion of consultation, but the intervention was meant to target scheduling, rather than aspects of consultation more related to patients' own behaviors. Attenuation of effect may be seen with a longer follow-up period.

In conclusion, with a Web-based referrals and scheduling system, referrals were nearly three times more likely to lead to a scheduled visit, after adjustment for other factors. Especially in a country with such a large supply of specialists, access to specialty care should not be hindered to such a large degree by the type of preventable error studied here. Although health information technology cannot solve all issues in our clinics, it can nearly eradicate the problem of failed scheduling. Nevertheless, even with computer-based approaches, scheduling systems can be better. An ideal system will have clinicians providing the key clinical pieces while other office staff handle key administrative elements. Further integrating referrals with a more robust clinical decision support system could lead to more appropriate referrals and fewer denials. Thus, to optimize clinical care, we'll need systems that do a better job of bringing together not only generalists and specialists, but clinicians and office staff, so that each role is effectively and efficiently served by those with the skills and expertise to match.

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