Clinician characteristics and use of novel electronic health record functionality in primary care

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ABSTRACT

Background Conventional wisdom holds that older, busier clinicians who see complex patients are less likely to adopt and use novel electronic health record (EHR) functionality.

Methods To compare the characteristics of clinicians who did and did not use novel EHR functionality, we conducted a retrospective analysis of the intervention arm of a randomized trial of new EHR-based tobacco treatment functionality.

Results The novel functionality was used by 103 of 207 (50%) clinicians. Staff physicians were more likely than trainees to use the functionality (64% vs 37%; p<0.001). Clinicians who graduated more than 10 years previously were more likely to use the functionality than those who graduated less than 10 years previously (64% vs 42%; p<0.01). Clinicians with higher patient volumes were more likely to use the functionality (lowest quartile of number of patient visits, 25%; 2nd quartile, 38%; 3rd quartile, 65%; highest quartile, 71%; p<0.001). Clinicians who saw patients with more documented problems were more likely to use the functionality (lowest tertile of documented patient problems, 38%; 2nd tertile, 58%; highest tertile, 54%; p=0.04). In multivariable modeling, independent predictors of use were the number of patient visits (OR 1.2 per 100 additional patients; 95% CI 1.1 to 1.4) and number of documented problems (OR 2.9 per average additional problem; 95% CI 1.4 to 6.1).

Conclusions Contrary to conventional wisdom, clinically busier physicians seeing patients with more documented problems were more likely to use novel EHR functionality.

INTRODUCTION

Electronic health records (EHRs) have been touted as a means of improving the quality of care in the United States. However, simply having an EHR, having certain EHR components, or using an EHR for a longer period of time have not been consistently associated with improved quality.[1–4] Some new EHR functionality, like clinical decision support (CDS), has shown potential in improving the quality of care,[5–8] but much new functionality goes unused or ignored.[9–11]

The national 'meaningful use' criteria recognize the need to extend EHR functionality beyond that of an electronic replacement for the paper chart.[12] Conventional wisdom holds that older physicians and busier physicians may be less likely to adopt novel clinical technologies.[3 13 14] However, understanding the characteristics of clinicians who are more or less likely to use novel EHR functionality, like that mandated by the meaningful use program,

could aid developers and health system leaders in more efficiently targeting design and implementation efforts.

We conducted a cluster randomized trial of novel, EHR-based, tobacco treatment functionality.[15] The novel functionality led to increased documentation of tobacco use status, increased counseling referral rates, and increased contact between documented smokers and tobacco counseling. Despite these improvements, only half of the clinicians in intervention practices used the novel functionality. To identify the characteristics of the clinicians who did and did not use the novel EHR functionality, we conducted a retrospective analysis of the intervention arm of a randomized controlled trial of an implementation of a new EHR-based tobacco treatment CDS system.

METHODS
Setting and intervention

The Partners Primary Care Practice-Based Research Network includes primary care practices that use the Longitudinal Medical Record (LMR), an internally developed, web-based, fully functional EHR.[16] We performed a cluster randomized controlled trial of tobacco treatment enhancements in primary care practices between December 2006 and September 2007 (http://www.ClinicalTrials.gov identifier: NCT00383461).[15] Twelve of 26 practices were randomly assigned to receive the intervention which consisted of a three-part EHR enhancement: (1) smoking status icons; (2) tobacco treatment reminders; and (3) a Tobacco Smart Form that facilitated medication ordering, and fax and email counseling referrals. The first two of these interventions were passive. The Tobacco Smart Form is one of a novel set of EHR applications that provide documentation-based CDS.[17 18]

The enhancements were implemented in intervention practices with an introductory email to clinicians, one practice visit by an investigator, and periodic emails to encourage enhancement use. No incentives were provided to clinicians or patients. The Partners Institutional Review Board approved the trial protocol.

Data extraction and analysis

We defined 'use' of the novel functionality as having invoked the Smart Form and taken some action with it, which included changing a problem, medication, or allergy; saving a note; or executing an order. These are all at least one step beyond simply invoking and viewing the Smart Form, which we did not consider 'use.' Because using the

referral functionality was more involved than performing a single action with the Smart Form, we separately examined the number of clinicians who used the referral functionality from those who met the more minimal 'use' criteria only by using the Smart Form. We also defined 'heavy users' as clinicians who used the functionality more than the median number of times among users during the 9-month study period.

We compared clinicians who did and did not use the novel functionality based on clinician type; clinician gender; years since graduation from medical or graduate school (a proxy for age); patient volume during the intervention period (total visits to the clinician in quartiles), which served as a proxy for clinical 'busyness'; mean percent documented smokers in clinicians' practice in quartiles; and clinic type. To assess patient complexity, we examined tertiles of the mean number of 13 common medical problems for the patients of each clinician.

Statistical analysis

We compared clinicians who did with those who did not use the functionality and heavy users with non-heavy users using Fisher's exact test. To evaluate independent predictors of uptake, we used multivariable logistic regression, which assesses the independent relationship of each variable with the outcome, with novel functionality use as the dependent variable. We entered any covariates with $p<0.10$ on bivariate testing into the multivariable model. We modeled graduation year, patient volume, and mean documented patient problems per clinician as linear variables. We considered two-sided p values <0.05 significant for all analyses.

RESULTS
Clinician characteristics and intervention use

Clinicians (n=207) were 47% staff physicians, 49% trainees, and 4% nurse practitioners or physician assistants (table 1). Most clinicians graduated less than 10 years prior to the study. The median number of patients seen by clinicians during the 9-month study period was 204, reflecting the large number of clinicians who were trainees (mean visits, 122) or staff physicians who had large non-clinical responsibilities (eg, administration, teaching, research; mean visits, 499).

During the intervention period, 90 clinicians (43%) in the intervention practices used the Smart Form once or more. In addition, 74 clinicians (36%) used the novel EHR functionality to refer at least one patient to the tobacco treatment counselor. In all, 103 clinicians (50%) used either the Smart Form or referred a patient to the tobacco treatment counselor. The median number of uses was 6. Of clinicians who used the novel functionality, 19% used it once, 28% used it more than 15 times, and 11% used it more than 35 times.

The 12 practices ranged in size from six clinicians to 47 clinicians. Among practices, intervention use ranged from 37% (seven of 19 clinicians) to 100% (six of six clinicians). At the largest practice, use was 45% (21 of 47 clinicians).

Clinician characteristics and use of functionality

In bivariate testing, staff physicians were more likely than trainees to use the functionality (table 1). Clinicians who graduated more than 30 years, 20—30 years, and 10—20 years prior to the study were more likely to use the functionality than clinicians who graduated <10 years prior to the study. Clinically busier clinicians were more likely to use the functionality. Clinicians who, on average, saw patients with more documented problems were more likely to use the intervention.

These relationships appeared even more pronounced when clinicians who were heavy users of the intervention were examined (table 1). For example, staff physicians were more likely than trainees to be heavy users, and busier clinicians were more likely to be heavy users of the functionality.

In supplementary analyses to examine use among clinicians more representative of typical clinical practice, we excluded trainees and clinicians with the lowest quartile of patient visits. Among the remaining 96 clinicians, use of the functionality increased across remaining tertiles of visit volume from 44% in the first tertile, to 68% in the second tertile, and 72% in the third tertile (p=0.006). Use of the functionality increased across tertiles of documented patient problems from 43% in the first tertile, to 80% in the second tertile, and 80% in the third tertile (p=<0.001).

Multivariable modeling

In multivariable modeling, adjusting for factors with $p<0.10$ on bivariate testing, there were two independent predictors of intervention use: the number of patient visits during the intervention period (OR 1.2 per 100 additional patients; 95% CI 1.1 to 1.4) and documented patient problems (OR 2.9 per average additional problem; 95% CI 1.4 to 6.1). Clinician type (OR 0.7 for trainees vs staff physicians; 95% CI 0.3 to 1.7) and years since graduation (OR 1.0 for every 5 years since graduation; 95% CI 0.8 to 1.1) were not significant independent predictors of use. These results did not change when years since graduation were removed from the model, which was collinear with clinician type.

DISCUSSION

In the context of a cluster randomized trial of novel EHR-based functionality that improved tobacco treatment, 50% of clinicians in intervention practices interacted with the functionality in a significant way. Conventional wisdom holds that novel technology is more likely to be adopted by younger users who are more comfortable with technology and may have more time to explore novel functionality.[13] However, contrary to conventional wisdom, on bivariate testing, we found that older, clinically busier staff physicians who saw patients with more documented problems, were more likely to use novel EHR functionality and use it more heavily. In multivariable modeling, clinically busier physicians seeing patients with more documented problems were more likely to use novel EHR functionality.

Far from clinically busier clinicians not having time to explore novel functionality, they may have greater opportunities to explore the EHR, be more comfortable with the EHR, and have greater incentive in exploring potentially time-saving functionality. It is particularly interesting that clinicians who saw patients with more documented problems used the novel functionality more. On the one hand, these results are counterintuitive: clinicians who see more complicated patients may have less time to engage with novel functionality. On the other hand, busier clinicians may reap greater, more immediate benefits from novel EHR functionality. If the number of patient problems is a reflection of clinicians' interaction with the EHR—that is, clinicians are the ones entering the problems—the observed relationship is expected.

Other investigators have found various clinician-level factors related to the use of novel functionality. Somewhat in contrast to our results, Dixon and colleagues found that the amount of non-clinical time, but not workload or clinician age, was related

Table 1 Clinician characteristics and novel electronic health record functionality use

Characteristic	All clinicians, N (%)	Did not use intervention, N (%)	Used intervention, N (%)	p Value*	Heavy intervention use, N (%)†	p Value‡
Overall	207 (100)	104 (50)	103 (50)		55 (27)	
Type of clinician				<0.001		<0.001
Staff physician	98 (47)	35 (36)	63 (64)		41 (42)	
Trainee	101 (49)§	64 (63)	37 (37)		14 (13)	
NP or PA	8 (4)	5 (63)	3 (37)		0 (0)	
Clinician gender				0.33		0.64
Female	113 (55)	53 (47)	60 (53)		32 (28)	
Male	94 (45)	51 (54)	43 (46)		23 (24)	
Years since graduation				0.006		0.01
<10	134 (65)	78 (58)	56 (42)		28 (21)	
10—19	29 (14)	12 (41)	17 (59)		12 (41)	
20—29	26 (13)	6 (23)	20 (76)		12 (46)	
≥30	18 (9)	8 (44)	10 (56)		3 (17)	
Patient volume (quartiles)				<0.001		<0.001
0—42 visits	52 (25)	39 (75)	13 (25)		3 (6)	
43—204 visits	52 (25)	32 (62)	20 (38)		6 (12)	
205—528 visits	52 (25)	18 (35)	34 (65)		20 (38)	
>528 visits	51 (25)	15 (29)	36 (71)		26 (51)	
Documented smokers in practice (quartiles)				0.19		0.17
0—<5.7%	52 (25)	29 (56)	23 (44)		12 (23)	
5.8%—8.9%	52 (25)	27 (52)	25 (48)		16 (31)	
9.0%—15.3%	51 (25)	19 (37)	32 (63)		18 (35)	
>15.3%	52 (25)	29 (56)	23 (44)		9 (17)	
Mean patient problems¶ per clinician (tertiles)				0.04		0.03
<0.84 problems	69 (33)	43 (62)	26 (38)		11 (16)	
0.84—1.39 problems	67 (32)	28 (42)	39 (58)		19 (28)	
>1.39 problems	71 (34)	33 (46)	38 (54)		25 (35)	
Clinic type				0.89		0.24
Community health center	59 (29)	28 (47)	31 (52)		13 (22)	
Community-based clinic	78 (38)	40 (51)	38 (49)		26 (33)	
Hospital-based clinic	70 (34)	36 (51)	34 (49)		16 (23)	

*Intervention users versus non-users.
†Six or more uses.
‡Heavy intervention users versus non-users and non-heavy users.
§Trainees were 96 residents and five general medicine fellows.
¶The 13 potential problems included hypertension, hyperlipidemia, obesity, diabetes, heart disease, vascular disease, chronic obstructive lung disease, asthma, osteoporosis, seizures, cancer, depression or anxiety, and peptic ulcer disease.
NP, nurse practitioner; PA, physician assistant.

to self-reported information technology adoption.[19] Weingart and colleagues found that house officers were more likely to honor medication prescribing alerts than staff physicians.[9] Consistent with our findings, Sittig and colleagues found that clinicians say they are more likely to follow CDS for patients with five or more chronic conditions or patients on more than five medications, but not if they were behind schedule.[20] Physician specialty has been a predictor of use, with general internists less likely than family medicine doctors or pediatricians to use novel functionality like e-prescribing.[13]

This analysis has limitations that should be considered. The practices participating in this randomized controlled trial were academically affiliated, used a home-grown EHR, had mainly general internal medicine clinicians, had a high number of trainees, and were members of a 'benchmark leader' system in health information technology.[6] Our results may not be generalizable to other settings. Although clinician type was not an independent predictor of functionality use, trainees (overwhelmingly residents who have low ambulatory volume) may feel less engaged with ambulatory duties and the EHR than

staff physicians. This might partly—but not completely, given our supplementary analyses—explain the relationship between volume and use of novel functionality. Second, the relatively small sample size may limit the ability to detect differences based on some characteristics and limits our ability to carry out additional, restricted analyses. Third, this study was during the 9-month introduction of novel functionality; results may have changed if there had been a longer introductory period. Fourth, there could be differences in uptake between wholesale adoption of an EHR, core EHR functions (eg, e-prescribing), and more specialized, problem-specific functionality like tobacco treatment.

In conclusion, we found that clinically busier physicians seeing patients with more documented problems were more likely to use novel EHR functionality. Thus, being busy should not be used as an excuse for failure to adopt new technology. In implementing novel functionality, EHR developers and health system leaders should ensure that implementation is accompanied by good design, usefulness, attention to workflow, and aligned incentives.[19] The meaningful use incentives on their own should encourage greater EHR adoption and use of more

sophisticated EHR functionality.[12] In addition, better identification of clinician and practice characteristics associated with uptake and use of novel EHR functionality—avoiding assumptions about who will use new functionality—as well as monitoring of implementation will serve to increase the use of novel functionality and deliver on the quality gains promised by the use of EHRs.

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