The Impact of Electronic Health Record Use on Physician Productivity

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Objectives: To examine the impact of the degree of electronic health record (EHR) use and delegation of EHR tasks on clinician productivity in ambulatory settings.

Study Design: We examined EHR use in primary care practices that implemented a web-based EHR from athenahealth (n = 42) over 3 years (695 practice-month observations). Practices were predominantly small and spread throughout the country. Data came from athenahealth practice management system and EHR task logs.

Methods: We developed monthly measures of EHR use and delegation to support staff from task logs. Productivity was measured using work relative value units (RVUs). Using fixed effects models, we assessed the independent impacts on productivity of EHR use and delegation. We then explored the interaction between these 2 strategies and the role of practice size.

Results: Greater EHR use and greater delegation were independently associated with higher levels of productivity. An increase in EHR use of 1 standard deviation resulted in a 5.3% increase in RVUs per clinician workday; an increase in delegation of EHR tasks of 1 standard deviation resulted in an 11.0% increase in RVUs per clinician workday (P <.05 for both). Further, EHR use and delegation had a positive joint impact on productivity in large practices (coefficient, 0.058; P <.05), but a negative joint impact on productivity in small practices (coefficient, –0.142; P <.01).

Conclusions: Clinicians in practices that increased EHR use and delegated EHR tasks were more productive, but practice size determined whether the 2 strategies were complements or substitutes.

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For author information and disclosures, see end of text.

The centerpiece of the 2009 Health Information Technology for Economic and Clinical Health (HITECH) Act is $27 billion in incentives for providers who demonstrate "meaningful use" of electronic health records (EHRs).[1] The legislation was motivated by the belief that EHRs used in specific ways (eg, medication order entry with alerts for drug-drug interactions) would make care safer, more effective, and more efficient. The meaningful use measures specify the activities that must be performed using an EHR,[2] leaving ambulatory practices and hospitals to determine how to structure their work to accomplish them.

A major concern among physicians is that EHR adoption will hamper their productivity.[3] This concern is not without merit—several studies have shown that physicians spend extra time entering data into the EHR, which cuts into time with patients and can extend the length of the workday.[4,5] One strategy for dealing with this productivity loss is to rely on support staff to perform EHR-related tasks. However, when work is interdependent, delegation has its own costs; it increases the need for coordination, which may require additional physician time.[6] Because scope-of-practice regulations prevent support staff from performing many clinical activities autonomously, physicians who successfully delegate must still spend time reviewing and authorizing staff activities.

For example, a physician who uses support staff to enter orders into an EHR must review and sign them before they are submitted. It is unclear whether (or under what conditions) efficiency gains from delegation exceed the time required to communicate the orders that need to be entered, reviewed, and in some cases, corrected. Across all clinical activities, there is little empirical evidence to guide physicians about whether it is optimal to off-load EHR-related tasks to support staff, or whether doing so would make them less efficient due to costs of oversight and coordination.[7]

Our study used monthly EHR task-log data from more than 40 primary care practices to examine the relationship between physician productivity, the degree of EHR use, and the delegation of EHR tasks. We first examined the independent effects of EHR use and delegation on productivity, and then assessed their joint impact on productivity to shed light on whether delegation and EHR use operate as complements or substitutes. Finally, we explored whether these relationships differ by practice size. Our findings offer insight into how primary care practices can structure their work

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Take-Away Points

There is little guidance available to physicians on how best to structure work after adopting an electronic health record (EHR) to address concerns about productivity losses.

- Increasing EHR use and delegating EHR-related work to support staff do improve clinician productivity; however, doing both gives large practices an additional productivity bump, while there is a loss among small practices.
- As clinicians increasingly adopt EHRs in response to federal policy efforts, careful attention to how EHR-related work is organized—in particular, the potential for EHRs to interfere with work coordination—may be needed to avoid productivity losses.

after adopting an EHR to ensure that EHR use does not harm productivity.

METHODS

Sample, Data and Measures

We obtained panel data for all of the primary care and internal medicine practices (n = 42) that use both a web-based EHR and a billing and practice management system from athenahealth Inc (Watertown, Massachusetts). Practices were distributed throughout the country and had on average 4 clinicians (range, 1-14). The average length of time that practices used the EHR was 17 months, with a minimum of 6 months. All practices in our sample employed at least 1 clinical support staff member and therefore had the ability to delegate from clinicians (those who can bill for clinical services, predominantly physicians but also including nurse practitioners and physician assistants) to clinical support staff (eg, registered nurse, licensed practical nurse, medical assistant). Our data included monthly measures at the practice level from May 2006 through May 2009. Observations were included for each practice with at least 6 months of experience, beginning in the first full month after it adopted the EHR and ending in May 2009, when athenahealth created the data set (n = 695 practice-month observations).

We relied on data from 2 sources: (1) the billing and practice management software and (2) the EHR. The billing and practice management software captures practice and staff demographics, monthly appointment volume, and monthly billing data. The EHR tracks each of hundreds of discrete, time-stamped actions associated with patient care. These actions are best thought of as changes to fields within the EHR. For descriptive purposes, they are grouped into a more meaningful and manageable list of 32 clinical tasks. For example, the task "collect vitals" includes 30 fields (eg, height, weight) and a change to any field is captured as a distinct action (**eAppendix Table 1**, available at **www.ajmc.com**). The vendor then generated a data set with a count of the number of actions, grouped by task, performed by each staff member per month. We used these 2 data sources to create the measures of productivity, EHR use, and delegation described below.

Productivity. Physician efficiency and productivity have been defined and studied in a number of ways.[8-16] In the context of EHRs, physician productivity is most commonly used to refer to *throughput*—the number of services delivered in a given period of time. Physicians carefully weigh whether to make practice changes (eg, EHR adoption) based on their perception of whether the change affects this dimension of productivity. We measured monthly productivity at the practice level using work relative value units (RVUs), standardized units of production in healthcare that reflect the volume and intensity of services provided, and serve as the basis for fee-for-service reimbursement. Work RVUs are captured in the billing and practice management system, and include all work RVUs for which the practice billed, regardless of whether they were reimbursed by the specific payer. For each practice, we divided total work RVUs per month by the number of clinician workdays in the month. We then log transformed this variable to approximate a normal distribution. (We ran all our models with the untransformed version of the dependent variable to confirm that no results were driven by the transformation.)

EHR Use. To capture the degree of EHR use, we created a measure of average task frequency per appointment by dividing (1) the total number of actions across all tasks in the EHR conducted by all staff members in each month by (2) the number of appointments in the month. Our measure of EHR use relied on data taken directly from the EHR, eliminating any potential self-reporting bias, and was not limited to specific EHR functions such as order entry.[17-19] Our measure therefore captured a comprehensive picture of use. Our measure was also granular, capturing the distinct actions taken in the EHR, not simply whether the EHR was used. For example, the entry of each vital sign (eg, weight, height, blood pressure) was captured as a distinct action. That resulted in a robust measure of the average intensity of EHR use per visit in the month.

(As used in our models [described below], the measure relies on the identifying assumption that the underlying distribution of work per visit is consistent within a practice in a given calendar month. Therefore, increases in EHR use reflected greater use of the system to document work that was performed as opposed to reflecting increases in the volume of work itself. We empirically assessed the validity of this assumption by examining whether the number of monthly appointments predicted EHR use, using our base model specification. We found no evidence that more appointments were associated with higher levels of EHR use, suggesting that increased EHR use was not a reflection of increased work, but instead a reflection of increased documentation of work performed. However, because EHR use could also be a function of variation in the intensity with which patients are treated, we included month fixed effects to accommodate average changes in treatment intensity associated with seasons [eg, the flu season], and we included practice fixed effects under the assumption that patient treatment intensity is constant over time within practices.)

Delegation. Our delegation measure, calculated for each practice month and reported as a percentage, was the total number of actions across all tasks in the EHR conducted by clinical support staff divided by the total number of actions across all tasks in the EHR conducted by either clinical support staff or clinicians.

Interaction Between Delegation and EHR Use. To assess whether EHR use and delegation operate as complements or substitutes in their impact on productivity, we created a continuous interaction term by first centering each measure around its mean (to improve interpretability) and then multiplying it. A positive coefficient on this term reflects a complementary impact on productivity, and a negative coefficient reflects a substitutive joint impact on productivity.

Practice Size. To assess whether the relationships of interest varied by practice size, we split our sample in half (21 practices in each group), effectively splitting practices into those with 1 to 3 clinicians and those with 4 or more clinicians. In other analyses, we split our sample into thirds (14 practices in each group) with practice groups of 1 to 2 clinicians, 3 to 5 clinicians, and 6 or more clinicians. We interacted size-based dichotomous variables with EHR use, delegation, and the continuous interaction term. (Small [1-3 clinicians] and large [4+ clinicans] practices were not statistically different in terms of the length of time that they had used the system. For small practices, the average was 17.36 months; for large practices, the average was 16.05 months [P = .60 for difference in means].)

Analytic Approach. We used an ordinary least squares model that estimated log work RVUs per clinician workday within each practice-month as a function of the intensity of EHR use and the level of delegation. We then added the interaction between EHR use and delegation to the model above. In a final model, we included a 3-way interaction, multiplying our categorical measures of practice size by EHR use, delegation, and the interaction term. The interaction terms assessed whether EHR use and delegation operate as complements or substitutes; that is, whether the productivity impact of increasing one element increases (complement) or decreases (substitute) the impact of the other. Standard errors were clustered at the practice level. (Please refer to the **eAppendix Regression Model** at **www.ajmc.com** for our regression equation.)

All models included fixed effects at the practice level to control for practice-specific, time-invariant factors that might affect productivity (eg, a practice that includes both physicians and nurse practitioners compared with a practice composed solely of physicians). Additional controls included an indicator for the first 6 months following EHR adoption to allow for an implementation period in which work patterns may be in flux; a measure of the proportion of clinicians in the practice under 35 years of age to account for the possibility that recent medical school graduates may be more skilled EHR users; and the number of clinical and administrative support staff per clinician in the practice—each of which may influence the level of delegation as well as productivity. (Since we were concerned that controlling for the number of support staff would negate the effect of a practice that chose to increase support staff in order to delegate more, we re-ran our models without these 2 variables. Our results did not materially differ and the results we present include them.)

We used the subset of tasks for which there is a "collect" (ie, newly entered) and a "review" (ie, viewed but not changed) option (eg, allergies; **Table 1**) to control for the monthly ratio of new to existing data in the EHR. This adjusted for the extent to which data need to be newly entered in the month, which could result from a changing patient mix or the approach of transitioning from paper to electronic records (eg, up-front conversion of all records, gradual conversion upon first patient visit), both of which may influence the intensity of EHR use and productivity. We included a full set of calendar month indicators to account for the possibility that productivity might be affected by seasonal changes in patient volume and illness severity (eg, flu season, holidays).

RESULTS

Summary Statistics

Average productivity in our sample was 17.5 RVUs (2.86 log RVUs) per clinician workday (**Table 2**). That is equivalent to approximately six 1-hour visits with a complex new patient, which are assigned 3.0 work RVUs each by Medicare. The average degree of EHR use in our sample was 370 actions per appointment. On average, clinicians delegated EHR tasks to clinical support staff 16% of the time (Table 2), although that varied widely across tasks (Table 1; results stratified by practice size are reported in **eAppendix Table 2**, available at **www.ajmc.com**).

Model Results. More intensive EHR use and greater delegation of EHR tasks were independently associated with high-

Table 1. Task Completion by Role: Sample Averages

Task	Clinical Support Staff, %	Clinicians, %
Assess and diagnose	21	79
Collect allergy	76	24
Collect common history	57	43
Collect encounter reason	59	41
Collect history of present illness	29	71
Collect medication list	56	44
Collect past history	82	18
Collect problem list	44	56
Collect special history	62	38
Collect vaccine	62	38
Collect vitals	92	8
Conduct physical exam	16	84
Conduct procedure	38	63
Conduct review of systems	21	79
Follow-up plan	9	91
Interpret clinical data	43	57
Respond to clinical request—authorization	18	82
Respond to clinical request—prescription from pharmacy	22	78
Review allergy	74	26
Review clinical data	17	83
Review common history	68	32
Review documents	12	88
Review imaging	18	82
Review lab data	27	73
Review medication list	65	35
Review past history	75	25
Review problem list	47	53
Review social history	62	38
Review special history	66	34
Review surgical history	63	37
Review vaccine	61	39
Send out orders	22	78

er productivity (coefficient of 0.029 for EHR use and 0.502 for delegation; $P < .05$ for both, Table 3, column 1). That is, practices that increased the number of tasks performed in the EHR per visit realized increased clinician productivity and practices that increased the extent to which EHR tasks were performed by clinical support staff as opposed to clinicians saw an independent increase in productivity. To understand the magnitude of the effects, an increase in EHR use of 1 standard deviation (from the mean level of 370 tasks per appointment to 548 tasks per appointment) was associated with a 5.3% increase in RVUs per clinician workday. That represents an increase of 0.9 RVUs above the sample average of 17.5 RVUs per workday, which is approximately equivalent to an additional 20-minute visit with a patient new to the practice. An increase in delegation of 1 standard deviation (from the mean level of 16% to 37%) resulted in an 11.0% increase in RVUs per clinician workday. That represents an increase of 1.9 RVUs above the sample average and is approximately equivalent to a 40-minute visit with an established patient. (We confirmed constant variance by splitting our sample in half by

Table 2. Descriptive Statistics From 42 Primary Care Practices

Variable	Obs	Mean	SD	Minimum	Maximum
Work relative value units per provider workday (log)	695	2.86	0.48	1.31	4.08
Electronic health record use (in thousands)	695	0.37	0.18	0.00	1.22
Clinical task delegation	695	0.16	0.21	0.00	1.00
Proportion of clinicians under age 35 years	695	0.06	0.15	0.00	0.90
Ratio of clinical support staff to clinicians	695	2.22	1.57	0.00	14.00
Ratio of administrative support staff to clinicians	695	1.91	1.26	0.00	7.00
Ratio of newly entered to reviewed data	695	3.22	1.97	0.36	22.83

Obs indicates the number of observations or "n;" SD, standard deviation.

practice size and then calculating the coefficient of variation on our untransformed dependent variable [RVUs per provider workday]. For the 21 small practices, the coefficient of variation was 0.4846; and for the 21 large practices, it was 0.4765. That reflected less than a 2% difference, so we did not apply a smearing method upon retransformation.)

On average across the entire sample, we did not find evidence that EHR use and delegation operate as either complements or substitutes (Table 3, column 2). The continuous interaction term was not statistically significant at conventional levels (coefficient, –0.057; $P = .23$). We did, however, find that the interaction varied by practice size, with evidence of a complementary relationship for large practices and a substitution relationship for small practices. Specifically, when we split the sample in half by size, the continuous interaction term was negative and significant for small practices (coefficient, –0.142; $P < .01$; Table 3, column 3). For large practices, the interaction term was positive and significant (coefficient, 0.200; $P < .01$), as was the total interaction effect (0.058 from the sum of –0.142 and 0.200; $P < .05$ from a postestimation test that the sum of the 2 coefficients was not equal to zero). We found similar results when we split our sample into thirds, with a negative, significant interaction effect for the smallest practice size group (coefficient, –0.133; $P < .01$; Table 3, column 4) and a positive, significant interaction effect for the largest group of practices (coefficient, 0.224; $P < .01$). The total interaction effect for the largest group of practices was also positive, though not statistically significant (.091 from the sum of –0.133 and 0.224; $P = .16$ from a postestimation test of the sum of the 2 coefficients).

With respect to effect magnitudes in model 3 (see Table 3), for large practices at the mean level of delegation (13%), increasing EHR use from the mean to 1 standard deviation above the mean (367 to 529 actions) resulted in a small predicted increase in RVUs per workday of 0.69. At a higher level of delegation (26%; 1 standard deviation above the mean), the equivalent increase in EHR use resulted in a somewhat larger predicted increase in RVUs per clinician workday of 0.94. Compared with the mean RVUs per clinician workday in large practices of 18.73, these results reflected a 4% and a 5% increase, respectively. For small practices, at the mean level of delegation (18%), increasing EHR use 1 standard deviation above the mean (372 to 559 actions) increased predicted RVUs per workday by 0.81. At a higher level of delegation (27%; 1 standard deviation above the mean), the equivalent increase in EHR use resulted in a small predicted decrease in RVUs per clinician workday of –0.45. Compared with the mean RVUs per clinician workday in small practices of 20.07, these results reflected a 4% increase and a 2% decrease, respectively.

DISCUSSION

Our study is among the first to present empirical evidence on the productivity implications of practice choices about EHR use and the delegation of EHR-related work. Using a novel data set, we found that more intensive EHR use and greater delegation are independently associated with higher clinician productivity in ambulatory settings. We also found that EHR use and delegation operate as complements in large practices and as substitutes in small practices, suggesting that organizational size affects the marginal impact on productivity of EHR use and delegation. More broadly, our study addressed physician concerns about productivity losses from EHR adoption by presenting empirical data that such losses are not inevitable and that choices about how EHRs are used influence productivity.

Given the current increase in EHR adoption spurred by the Medicare and Medicaid EHR Incentive Programs, our findings have important implications for how practices approach EHR use. Although our results suggest that clinicians are more productive when they find ways to delegate tasks to support staff, practices should be aware of potentially unintended consequences when greater delegation is accompanied by more intensive EHR use. Specifically, in small practices—typically composed of a consistent, limited group

Table 3. Effect of Delegation and EHR Use on Provider Productivity

Variable	Coefficient (SE)[a] Model 1: EHR Use and Delegation	Model 2: EHR Use, Delegation, and Interaction	Model 3: EHR Use, Delegation, and Interaction by Size (Sample Split in Half)	Model 4: EHR Use, Delegation, and Interaction by Size (Sample Split in Thirds)
EHR use	0.029[b] (0.012)	0.028[b] (0.012)	0.027 (0.018)	0.014 (0.019)
Delegation[c]	0.502[b] (0.234)	0.496[d] (0.265)	0.852 (0.553)	1.261[e] (0.447)
EHR use × delegation		–0.057 (0.046)	–0.142[e] (0.042)	–0.133[e] (0.034)
EHR use × delegation (large practices)			0.200[e] (0.049)	
EHR use (large practices)			–0.001 (0.019)	
Delegation (large practices)			–0.554 (0.554)	
EHR use × delegation (middle practice size tertile)				0.118 (0.149)
EHR use × delegation (large practice size tertile)				0.224[e] (0.072)
EHR use (middle practice size tertile)				0.025 (0.026)
EHR use (large practice size tertile)				0.013 (0.020)
Delegation (middle practice size tertile)				–1.075 (0.692)
Delegation (large practice size tertile)				–1.190[b] (0.510)
Implementation—first 6 months	0.013 (0.040)	0.012 (0.040)	0.009 (0.040)	0.01 (0.040)
Proportion of clinicians under age 35 years	–0.207 (0.160)	–0.255 (0.166)	–0.165[d] (0.093)	–0.171 (0.123)
Ratio of clinical support staff to clinicians	–0.021[b] (0.010)	–0.021[b] (0.010)	–0.018 (0.011)	–0.012 (0.010)
Ratio of administrative support staff to clinicians	0.033 (0.022)	0.033 (0.021)	0.033 (0.021)	0.033 (0.020)
Ratio of newly entered to reviewed data	–0.003 (0.008)	–0.003 (0.008)	–0.003 (0.008)	–0.005 (0.009)
Practice fixed effects	Included	Included	Included	Included
P value from postestimation *F* test for medium-size practice interaction effect				.919
P value from postestimation *F* test for large-size practice interaction effect			0.016	0.158
Observations	695	695	695	695
Practices	42	42	42	42
R^2	0.109	0.113	0.130	0.139
Log-likelihood	310.755	312.248	318.894	322.304

EHR indicates electronic health record; SE, standard error.
[a]This table reports coefficients from ordinary least squares fixed effects regression models. Standard errors are robust and are clustered by practice.
[b]$P < .05$.
[c]The relationship between delegation and clinician productivity was largely robust to the inclusion of different subsets of tasks in our measure of delegation. Specifically, we examined delegation for the 10 most commonly delegated tasks as well as delegation for the 10 least commonly delegated tasks (based on sample averages reported in Table 1). We found a positive relationship in both cases, although the former was only marginally significant (coefficient, 0.195; $P = .13$) and the latter was highly significant (coefficient, 0.273; $P = .001$). See eAppendix Table 3 and Table 4, available at www.ajmc.com.
[d]$P < .10$.
[e]$P < .01$.

of clinicians and support staff—the coordination challenges created by delegation may be relatively small, as individuals have more direct interaction with one another and are accustomed to coordinating and adjusting in an ad hoc manner. However, in small practices, these same factors may serve to interfere with, rather than improve, coordination in the face of reduced interpersonal contact resulting from EHR use. In larger practices, cohesive, stable teams are less common, resulting in increased reliance on a depersonalized set of roles that define the tasks of each type of staff member and minimize the amount of coordination required to work together efficiently.[20] Having these explicit task expectations in place may be what enables larger practices to gain greater productivity benefits from increased EHR use in the presence of high levels of delegation. There are other potential explanations for the size-based difference that we observed. For example, large practices may spend more time on training and work flow redesign, thereby achieving greater productivity benefits.

For policy makers designing future stages of meaningful use criteria, the contingent relationship between approaches to EHR use and clinician productivity based on practice size could suggest a differential impact of meaningful use on the quality and efficiency of care. Because physicians will be expected to demonstrate that meaningful use results in improved care, understanding the key contextual factors that shape these gains will help inform the establishment of targets.

Much of the literature to date examined the impact of EHRs on physician productivity by treating adoption dichotomously and comparing performance before and after EHR adoption.[21-23] These studies speak to the average impact of EHR adoption on productivity, not to what explains variation in clinician performance after adopting an EHR, a key contribution of our study. Prior studies also focused largely on the use of specific functionalities within the EHR,[24,25] as opposed to more comprehensive measures. Our study extends the current literature by directly measuring EHR *use*—not simply EHR adoption—across a wide range of EHR-related tasks, revealing that increased use leads to meaningful productivity gains. More broadly, our study offers an example of the new type of research that is made possible by the window that EHRs provide into how practices deliver care.

Our study has several potential limitations. First, though we attempted to include a comprehensive set of covariates in our models, omitted variables might have biased our results. In particular, we were not able to account for the length of the clinician workday. Second, our results might also reflect bias introduced by several types of potential measurement error. Tasks recorded in the EHR could be attributed to the incorrect staff type if staff members either logged in to the system using the credentials of an employee of another staff type or if the most recent user failed to log off properly, introducing error into our delegation measure. Anecdotal data collected from athenahealth staff suggest that this behavior is uncommon, and when it does occur, it typically involves support staff logging in as clinicians (to access functionality not available to lower-level staff). That would have resulted in our delegation measure underestimating the true level of delegation, therefore making it harder to find support for our hypotheses.

Third, our measure of EHR use did not distinguish more intensive use from inefficient use (eg, re-entering incorrect vital signs would appear as more intensive use). However, inefficient use should result in a negative relationship with productivity and therefore work against our observation of a positive, significant relationship between greater system use and productivity. Fourth, observed productivity gains may, in fact, have been improvements in charge capture (ie, more accurate documentation of services provided to ensure full payment).[4,26] Though increased EHR use may lead to better documentation that facilitates higher coding without improved underlying productivity, this possibility would not explain our findings related to delegation. Finally, there are limitations related to the generalizability of our findings. The practices in our sample are early adopters and our analytic period predates meaningful use. In addition, all practices used the same EHR system, which was designed to adapt to an array of physician preferences about how to document clinical data. This may limit generalizability, but also holds the advantage of ensuring that our results are not driven by differences in the underlying EHR system.

Even with these limitations, our study advances understanding of the relationship between the use of EHRs—the predominant type of health information technology tied to billions of dollars in new federal incentives—and productivity outcomes of great concern to physicians. We found that both increased EHR use and delegation result in meaningful productivity gains, but that practice size influences the extent to which they operate as complements or substitutes in their joint impact on productivity. Deeper investigation of these issues is a fruitful avenue for future research to bolster understanding of the organizational factors that shape the productivity implications of EHR use.

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eAppendix

Table 1. Example of a Task and Associated Field Codes

Task	**Field Codes**
Collect vitals	VITALS.BMI VITALS.ENCOUNTERDATE VITALS.HEIGHT VITALS.WEIGHT VITALS.BLOODPRESSURE.DIASTOLIC VITALS.BLOODPRESSURE.SITE VITALS.BLOODPRESSURE.SYSTOLIC VITALS.BLOODPRESSURE.TYPE VITALS.BMI VITALS.COLOROD VITALS.COLOROS VITALS.CORRECTION VITALS.HEADCIRCUMFERENCE VITALS.HEIGHT VITALS.LMP VITALS.NECKCIRCUMFERENCE VITALS.NOTES VITALS.O2SATURATION VITALS.PAINSCALE VITALS.PULSE.RATE VITALS.PULSE.TYPE VITALS.RESPIRATIONRATE VITALS.TEMPERATURE VITALS.TEMPERATURE.TYPE VITALS.VOD VITALS.VOS VITALS.WAISTCIRCUMFERENCE VITALS.WEIGHT VITALS.WEIGHT.OUTOFRANGE VITALS.WEIGHT.REFUSED

Table 2. Task Completion by Role: Sample Averages by Size[a]

	Small		Large	
Task	**Clinical Support Staff**	**Clinicians**	**Clinical Support Staff**	**Clinicians**
Assess and diagnose	23%	77%	21%	79%
Collect allergy	51%	49%	66%	34%
Collect common history	48%	52%	51%	49%
Collect encounter reason	61%	39%	53%	47%
Collect history of present illness	42%	58%	27%	73%
Collect medication list	46%	54%	66%	34%
Collect past history	68%	32%	58%	42%
Collect problem list	15%	85%	27%	73%
Collect special history	61%	39%	67%	33%
Collect vaccine	56%	44%	56%	44%
Collect vitals	97%	3%	82%	18%
Conduct physical exam	14%	86%	14%	86%
Conduct procedure	13%	87%	32%	68%
Conduct review of systems	20%	80%	18%	82%
Follow-up plan	3%	97%	14%	86%
Interpret clinical data	61%	39%	55%	45%
Respond to clinical request—	13%	87%	14%	86%

authorization				
Respond to clinical request—prescription from pharmacy	24%	76%	30%	70%
Review allergy	43%	57%	74%	26%
Review clinical data	20%	80%	16%	84%
Review common history	44%	56%	58%	42%
Review documents	17%	83%	7%	93%
Review imaging	18%	82%	16%	84%
Review lab data	24%	76%	26%	74%
Review medication list	44%	56%	69%	31%
Review past history	72%	28%	65%	35%
Review problem list	16%	84%	30%	70%
Review social history	51%	49%	54%	46%
Review special history	56%	44%	72%	28%
Review surgical history	44%	56%	59%	41%
Review vaccine	74%	26%	75%	25%
Send out orders	26%	74%	23%	77%

[a]Differences greater than 20 percentage points (dark blue) and 10 percentage points (light blue).

Table 3. Tasks Included in Alternate Measures of Delegation

Task	Clinical Support Staff	Physician	Included in New Measure of Most Commonly Delegated	Included in New Measure of Least Commonly Delegated
Follow-up plan	9%	91%		X
Review documents	12%	88%		X
Conduct physical exam	16%	84%		X
Review clinical data	17%	83%		X
Respond to clinical request—authorization	18%	82%		X
Review imaging	18%	82%		X
Assess and diagnose	21%	79%		X
Conduct review of systems	21%	79%		X
Respond to clinical request—prescription from pharmacy	22%	78%		X
Send out orders	22%	78%		X
Review lab data	27%	73%		
Collect history of present illness	29%	71%		
Conduct procedure	38%	63%		
Interpret clinical data	43%	57%		
Collect problem list	44%	56%		
Review problem list	47%	53%		
Collect medication list	56%	44%		
Collect common history	57%	43%		
Collect encounter reason	59%	41%		
Review vaccine	61%	39%		

Collect special history	62%	38%		
Collect vaccine	62%	38%		
Review social history	62%	38%	X	
Review surgical history	63%	37%	X	
Review medication list	65%	35%	X	
Review special history	66%	34%	X	
Review common history	68%	32%	X	
Review allergy	74%	26%	X	
Review past history	75%	25%	X	
Collect allergy	76%	24%	X	
Collect past history	82%	18%	X	
Collect vitals	92%	8%	X	

Table 4. Regression Results With Alternate Measures of Delegation

	Model 1	Model 2	Model 3
	EHR Use and Delegation: All Tasks	**EHR Use and Delegation: Most Commonly Delegated Tasks**	**EHR Use and Delegation: Least Commonly Delegated Tasks**
EHR use	0.029[a]	0.029[a]	0.029[a]
	[0.012]	[0.013]	[0.011]
Delegation	**0.502**[a]	**0.195**	**0.273**[b]
	[0.234]	**[0.128]**	**[0.080]**
Implementation: first 6 months	0.013	0.016	0.015
	[0.040]	[0.041]	[0.041]
Proportion of clinicians under age 35 years	–0.207	–0.193	–0.214
	[0.160]	[0.165]	[0.171]
Ratio of clinical support staff to clinicians	–0.021[a]	–0.022[a]	–0.026[a]
	[0.010]	[0.010]	[0.011]
Ratio of administrative support staff to clinicians	0.033	0.032	0.036
	[0.022]	[0.022]	[0.024]
Ratio of newly entered to reviewed Data	–0.003	–0.002	–0.001
	[0.008]	[0.009]	[0.008]
Practice and month fixed effects	Included	Included	Included
Observations	695	695	695
Practices	42	42	42
R^2	0.109	0.099	0.121
Log-likelihood	310.755	306.764	315.266

[a]*P* <.05.

[b]*P* <.01.

Regression Model

We estimated the following ordinary least squares model:

$$\textit{Log Work RVUs per Provider Workday}_{jt} = \beta 1 * \textit{EHRUse}_{jt} + \beta 2 * \textit{Delegation}_{jt} + \beta 3 * \textit{Implementation}_{t} + \beta 4 * \textit{PhysiciansUnder35}_{jt} + \beta 5 * \textit{ClinicalStaffRatio}_{jt} + \beta 6 * \textit{AdminStaffRatio}_{jt} + \beta 7 * \textit{NewVsReviewedDataRatio}_{jt} + \textit{Month}_{t} + \alpha_j + \varepsilon_{jt}$$

This model estimates the logged work RVUs per physician workday within practice *j* in month *t* as a function of the intensity of EHR use ($EHRUse_{jt}$) and the level of delegation ($Delegation_{jt}$). We included an indicator for the first 6 months following adoption ($Implementation_{t}$) and a measure of the proportion of physicians in the practice under 35 years of age ($PhysiciansUnder35_{jt}$). We controlled for the number of clinical and administrative support staff per physician in the practice ($ClinicalStaffRatio_{jt}$ *and* $AdminStaffRatio_{jt}$) as well as for the ratio of newly entered data to data already in the EHR that is reviewed ($NewVsReviewedDataRatio_{jt}$). We included a full set of calendar month indicators ($Month_{t}$) as well as fixed effects at the practice level (α_j) to control for practice-specific, time-invariant factors that might affect productivity.