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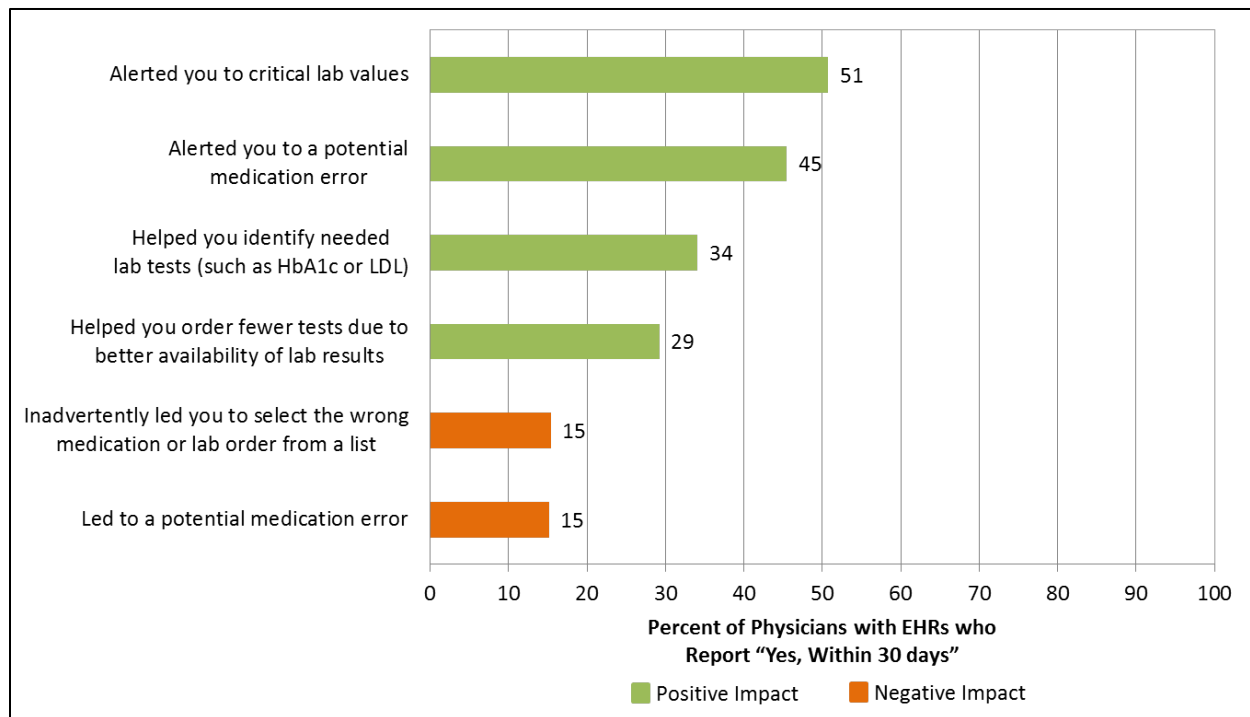
Physician-Reported Safety and Quality Impacts of Electronic Health Record Use

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There are widespread hopes and increasing evidence that expanded use of electronic health records (EHRs) will improve health care quality and patient safety.^{1,2,3} These improvements may be enabled by EHR functionalities such as those that provide preventive care reminders, accurate patient information when needed, and clinical decision support that assists with diagnoses and chronic care management.⁴ On the other hand, there are concerns that EHRs could present threats to patient safety resulting from complex data interfaces, poor user-interface design or poor workflow implementation.⁵ This brief uses data from the 2013 National Ambulatory Medical Care Physician Workflow Survey to assess physician-reported impacts of EHR use – both positive and negative – on health care quality and patient safety related outcomes.

Three times as many physicians reported that their EHR prevented a potential medication error than caused one.

Figure 1: Proportion of physicians using EHRs who reported that EHR use led to positive or negative impacts associated with medication and laboratory alerts and reminders, 2013.

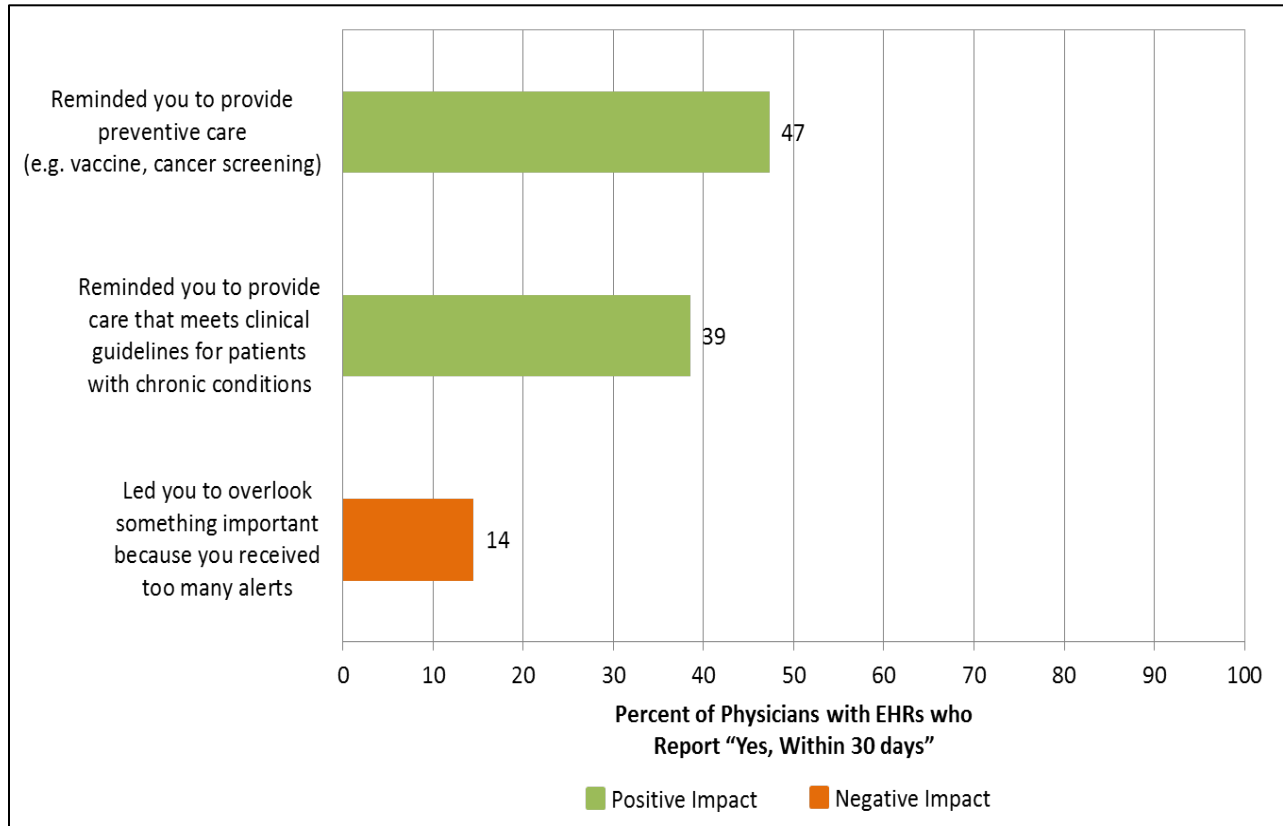


SOURCE: 2013 National Ambulatory Medical Care Survey Physician Workflow Survey. See Table A1 for question details.

★ Half of physicians using an EHR reported that the system alerted them to critical laboratory values.

Almost half of all physicians using EHRs were reminded to provide preventive care by their EHRs.

Figure 2: Proportion of physicians using EHRs who reported that EHR use led to positive or negative impacts associated with general alerts and reminders, 2013.

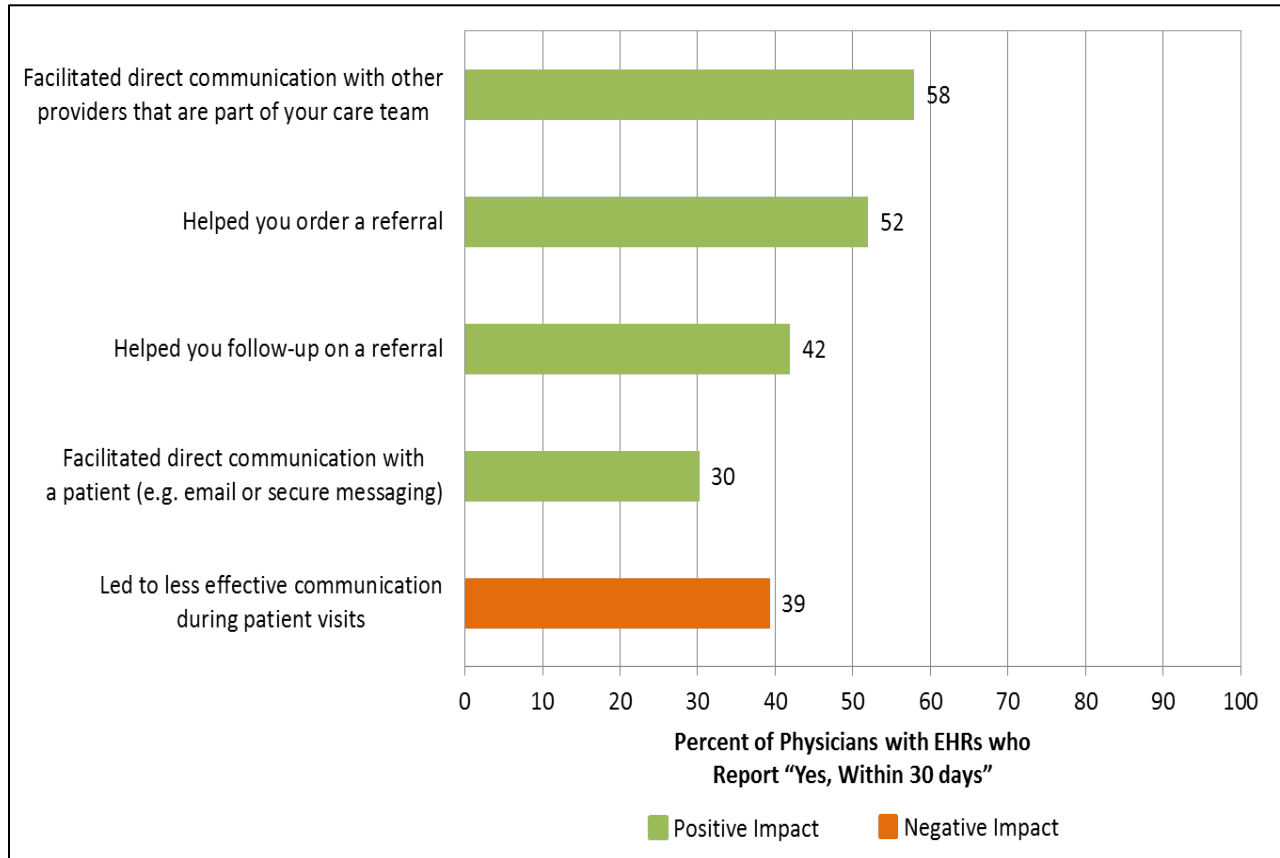


SOURCE: 2013 National Ambulatory Medical Care Survey Physician Workflow Survey. See Table A1 for question details.

- ★ Four in ten physicians using EHRs reported receiving reminders about chronic condition clinical care guidelines from their EHRs.
- ★ Fourteen percent of physicians with EHRs reported that their EHR caused them to overlook something because they received too many alerts.

The majority of physicians using EHRs said that their EHR facilitated direct communication with other providers.

Figure 3: Proportion of physicians using EHRs who reported that EHR use led to positive or negative impacts associated with EHR-facilitated communication, 2013.



SOURCE: 2013 National Ambulatory Medical Care Survey Physician Workflow Survey. See Table A1 for question details.

- ★ A majority of physicians using EHRs said that their EHR facilitated direct communication with other providers (58%) and helped with referrals (52%).
- ★ Provider-to-patient communication facilitated through EHR use was less common: 30% of physicians using EHRs reported that their EHR facilitated direct communication with patients through email or secure messaging.
- ★ Almost 4 in 10 physicians who used EHRs said that their use of the technology led to less effective communication during patient visits.

Physicians using EHRs that met Meaningful Use criteria were significantly more likely to report safety improvements associated with EHRs than physicians without that technology.

Table 1: Statistically significant adjusted relative risks for improved safety and quality impacts associated with EHR use, by physician and practice characteristics, 2013.

	Any Positive Medication/ Laboratory Orders & Results	Any Positive General Reminders & Alerts	Any Positive Communication
Overall percent among physicians using EHRs	69%	51%	70%
Specialty			
Primary care	1.26	1.19	1.12
Other specialty (comparison group)	1.00	1.00	1.00
Practice Size			
2 physicians	--	--	--
3-5 physicians	--	--	1.12
6-10 physicians	--	--	1.12
11+ physicians	1.14	--	1.15
Solo practice (comparison group)	1.00	1.00	1.00
Practice Ownership			
Community health center	--	--	--
HMO, insurance plan, or other health care corp.	1.11	1.23	1.18
Hospital or academic medical center	--	--	--
Physician/Group owned (comparison group)	1.00	1.00	1.00
Participation in Delivery Reform (PCMH, ACO, or pay-for-performance)			
Yes	1.10	1.09	1.11
No (comparison group)	1.00	1.00	1.00
EHR Technology			
EHR meets MU criteria	1.22	1.26	1.19
EHR does not meet MU criteria, or unknown (comparison group)	1.00	1.00	1.00
Length of EHR Install			
5+ years	--	--	1.28
2-4 years	--	--	1.19
1 year	--	--	--
<1 year (comparison group)	1.00	1.00	1.00

NOTES: The regression model controlled for the characteristics listed above, as well as physician sex, age, and practice location (urban vs. rural). The characteristics without numeric values were not significantly different to the comparison group. All adjusted RRs available in Table A2.

SOURCE: 2013 National Ambulatory Medical Care Survey Physician Workflow Survey. See Table A1 for details on questions and categories.

- ★ When compared with physicians using EHRs that did not meet Meaningful Use criteria, physicians with meaningful use-enabled EHRs reported their systems were: 26% more likely generate general alerts and reminders that improve patient care, 22% more likely to demonstrate positive medication or laboratory impacts, and 19% more likely to enhance communication.

Negative safety impacts associated with EHRs were fairly consistent across most categories.

Table 2: Statistically significant adjusted relative risks, by physician and practice characteristics, for areas of decreased patient safety associated with EHR use, 2013.

	Led to less effective communication during patient visits	Led you to overlook something important because you received too many alerts	Led to a potential medication error	Inadvertently led you to select the wrong medication or lab order from a list
Overall percent among physicians using EHRs	39%	14%	15%	15%
Specialty				
Primary care	--	1.10	1.09	1.08
Other specialty (comparison group)	1.00	1.00	1.00	1.00
Practice Size				
2 physicians	--	--	--	--
3-5 physicians	--	--	--	--
6-10 physicians	--	--	--	--
11+ physicians	--	--	--	--
Solo practice (comparison group)	1.00	1.00	1.00	1.00
Practice Ownership				
Community health center	1.28	--	--	--
HMO, insurance plan, or other health care corp.	--	--	--	--
Hospital or academic medical center	1.16	--	--	--
Physician/group owned (comparison group)	1.00	1.00	1.00	1.00
Participation in Delivery Reform (PCMH, ACO, or pay-for-performance)				
Yes	--	--	--	--
No (comparison group)	1.00	1.00	1.00	1.00
EHR Technology				
EHR meets MU criteria	--	1.09	--	1.06
EHR does not meet MU criteria, or unknown (comparison group)	1.00	1.00	1.00	1.00
Length of EHR Install				
5+ years	--	--	--	--
2-4 years	--	--	--	--
1 year	--	--	--	--
<1 year (comparison group)	1.00	1.00	1.00	1.00

NOTES: The regression model controlled for the characteristics listed above, as well as physician sex, age, practice location (urban vs. rural), and time since EHR installation. The characteristics without numeric values are not significantly different to the comparison group. All adjusted RRs available in Table A3.

SOURCE: 2013 National Ambulatory Medical Care Survey Physician Workflow Survey. Questions defined in Table A1.

- ★ Compared to physicians using EHRs that did not meet Meaningful Use criteria, physicians with meaningful use-enabled EHRs were 9% more likely to report overlooking something important due to too many alerts and 6% more likely to report inadvertently selecting the wrong medication or lab from a list.



Summary

This brief highlights the many areas where patient safety and quality of care may be improved through the use of EHRs. There are, however, a small but significant percent of reports where safety and quality may be negatively impacted from EHR use.

Use of EHRs that met Meaningful Use criteria was significantly associated with all areas of improved patient safety and quality of care.

Technology alone, however, will not eliminate all patient harm or patient safety events.⁶ Consistently, physicians with EHRs participating in delivery reform (patient-centered medical homes, accountable care organizations, and pay-for-performance programs), or located in practices owned by HMOs and other insurance organizations, were more likely than their comparison groups to report EHR-associated improvements in patient safety and quality of care. These are groups that generally implement workflow changes in addition to adopting health information technology.⁷

There were not many characteristic-based differences among providers reporting negative impacts associated with EHR use. Physicians using EHRs that met Meaningful Use criteria were more likely to report potential problems stemming from selection of the incorrect medication or laboratory order due to a poorly structured list, as well as overlooking something as a result of too many alerts. The proportion of physicians using EHRs who reported these problems was 16% for poorly structured lists and 17% for overlooking something due to too many alerts.

It should be noted that the information presented here about potential safety impact caused by electronic health records are reported in isolation. That is, there are many other sources of potential patient harm. Patient safety events happen every day, with and without health information technology.^{8,9} This brief demonstrates that EHR use among physicians is associated with more positive impacts than negative.



Definitions

Positive impacts: Includes nine questions from the Physician Workflow Survey, listed in Table A1 below with “Positive” in the “Safety Impact” column.

Negative impacts: Includes four questions from the Physician Workflow Survey, listed in Table A1 below with “Negative” in the “Safety Impact” column.

EHR meets Meaningful Use (MU) criteria: Physician indicated in the survey that the EHR technology being used at the reporting location meets the criteria for Meaningful Use (referring to the CMS EHR Incentive Program).¹⁰

Participation in delivery reform activities: Physician responded affirmatively to at least one of the following questions:

- Does the reporting location participate in a certified PCMH arrangement?
- Does the reporting location participate in a Pay-for-Performance arrangement?
- Does the reporting location participate in an Accountable Care Organization or similar arrangement?

Data Source and Methods

The Centers for Disease Control and Prevention conducts the NAMCS survey on an annual basis. The Physician Workflow Survey, which is the basis of the data presented here, is a supplement to the NAMCS survey. Physicians included in this survey provide direct patient care in office-based practices and community health centers; excluded are those without direct patient care (radiologists, anesthesiologists, and pathologists). Additional documentation regarding the survey is available here: http://www.cdc.gov/nchs/ahcd/ahcd_survey_instruments.htm

Questions used from the survey to assess patient safety and quality of care impacts are listed in Table A1, with corresponding category assignment and whether the question was a reflection of a positive or negative safety impact. Physicians were counted in the numerator for proportions if they indicated “Yes, within the last 30 days” in response to the question. All physicians who were actively using EHR technology at the time of the survey were included in the denominator, unless “N/A” was indicated as a response for the specific question. For any analysis based on the grouped categories, physicians were excluded only if they responded “N/A” to all questions in the category.

Adjusted relative risks were calculated using the surveyreg procedure in SAS version 9.3.^{11, 12} Composite measures for the positive impacts were used in the regression models only after it was determined that the variability within each grouping’s individual questions was minimal, and that the composite measure results were similar. The multivariate regressions controlled for physician characteristics such as age, sex, and specialty; practice characteristics including practice size, participation in delivery reform (pay-for-performance, patient-centered medical home, and/or Accountable Care Organization), rural/urban location (based on the 2012 Area Resource File¹³), using the physician’s county to determine whether they were in a metropolitan area (urban) or rural (not metropolitan), and practice ownership; and EHR characteristics (length of EHR installation and whether the EHR technology meets Meaningful Use criteria).



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Appendix

Table A1: Selected Safety-Related Questions from the 2013 National Ambulatory Medical Care Survey, Physician Workflow Survey

Analytic Category	Positive or Negative Impact	Question Text This question is about the ways that an EHR system might affect your reporting location. Has your EHR system:
Communication: Provider-to-Patient	Positive	Facilitated direct communication with a patient (e.g., email or secure messaging)?
Communication: Provider-to-Patient	Negative	Led to less effective communication during patient visits?
Communication: Provider-to-Provider	Positive	Facilitated direct communication with other providers that are part of your care team?
Communication: Provider-to-Provider	Positive	Helped you follow-up on a referral?
Communication: Provider-to-Provider	Positive	Helped you order a referral?
General reminders / alerts	Positive	Reminded you to provide preventive care (e.g., vaccine, cancer screening)?
General reminders / alerts	Positive	Reminded you to provide care that meets clinical guidelines for patients with chronic conditions?
General reminders / alerts	Negative	Led you to overlook something important because you received too many alerts?
Medication / Laboratory Orders and Results	Positive	Alerted you to a potential medication error?
Medication / Laboratory Orders and Results	Positive	Helped you identify needed lab tests (such as HbA1c or LDL)?
Medication / Laboratory Orders and Results	Positive	Helped you order fewer tests due to better availability of lab results?
Medication / Laboratory Orders and Results	Positive	Alerted you to critical lab values?
Medication / Laboratory Orders and Results	Negative	Led to a potential medication error?
Medication / Laboratory Orders and Results	Negative	Inadvertently led you to select the wrong medication or lab order from a list?

SOURCE: 2013 National Ambulatory Medical Care Survey Physician Workflow Survey.

Table A2: Adjusted Relative Risks for Improved Patient Safety Categories, by Physician and Practice Characteristics, 2013.

		Positive Communication Impacts	Positive General Reminders/ Alerts	Positive Medication/ Laboratory Orders and Results
Overall percent among physicians using EHRs		70%	51%	69%
Physician Sex	Female (vs. Male)	1.02	0.99	0.98
Physician Age	Under 50 (vs. Over 50)	1.04	1.02	1.05
Physician specialty	Primary Care (vs. other specialty)	1.12*	1.19**	1.26**
Practice Size (compared to Solo practices)	2 physicians	1.06	1.08	0.97
	3-5 physicians	1.12*	0.95	0.98
	6-10 physicians	1.12*	0.99	1.03
	11+ physicians	1.15*	0.95	1.15*
Practice Ownership (compared to Physician or Group owned)	HMO, insurance plan, or other health care corp.	1.18**	1.23*	1.11*
	Community Health Center	1.06	0.92	0.92
	Hospital or academic medical center	1.07	0.98	1.05
	Other / unknown	1.02	1.17	0.99
Participation in any delivery reform activities	Yes (vs. No)	1.11*	1.09*	1.10*
Rural Area	Rural (vs. Urban)	1.03	1.00	1.01
EHR meets MU Criteria	Yes (vs. No)	1.19*	1.26**	1.22**
Length of EHR Install (compared to less than 1 year)	1yr	1.12	1.06	1.15
	2-4 years	1.19*	1.08	1.10
	5+ years	1.28*	1.22	1.14

NOTE: This table includes the full regression results that are summarized on Table 1.

* indicates p-value of <0.05; ** indicates a p-value <0.0001

SOURCE: 2013 National Ambulatory Medical Care Survey Physician Workflow Survey. Categories and associated questions defined in Table A1.

Table A3: Adjusted Relative Risks for Areas of Decreased Patient Safety, by Physician and Practice Characteristics, 2013.

		Overlooking something because you received too many alerts	Potential medication error	Less effective communication during patient visits	Inadvertently selecting wrong medication or lab from a list
Overall percent among physicians using EHRs		14%	15%	39%	15%
Physician sex	Female (vs. Male)	1.04	1.00	1.01	1.06
Physician age	Under 50 (vs. Over 50)	1.02	1.02	1.01	1.02
Physician specialty	Primary care (vs. other specialty)	1.10*	1.09*	1.04	1.08*
Practice Size (compared to Solo practices)	2 physicians	1.01	0.93	0.97	0.97
	3-5 physicians	1.00	0.99	1.06	1.06
	6-10 physicians	1.07	0.99	1.13*	1.04
	11+ physicians	1.05	0.98	1.01	1.01
Practice Ownership (compared to physician or group owned)	HMO, insurance plan, or other health care corp.	1.02	0.98	1.04	1.03
	Community Health Center	1.07	1.14	1.28*	1.14
	Hospital or academic medical center	1.02	0.96	1.16*	1.05
	Other / unknown	1.02	1.04	1.11	0.95
Participation in any delivery reform activities	Yes (vs. No)	1.02	1.01	1.00	1.01
Rural Area	Rural (vs. Urban)	1.02	1.03	0.92	1.04
Using CEHRT	Yes (vs. No)	1.09*	1.04	1.10	1.06*
Length of EHR Install (compared to less than 1 year)	1yr	1.04	1.04	0.99	1.02
	2-4 years	1.01	1.04	0.92	1.04
	5+years	0.98	1.01	0.82	0.96

NOTE: This table includes the full regression results that are summarized on Table 2. * indicates p-value of <0.05. SOURCE: 2013 National Ambulatory Medical Care Survey Physician Workflow Survey. Categories and associated questions defined in Table A1.