© Published 2016. This article is a U.S. Government work and is in the public domain in the USA
DOI: 10.1111/1475-6773.12481
RESEARCH ARTICLE

Physician and Practice-Level Drivers and Disparities around Meaningful Use Progress

Dawn Heisey-Grove and Jennifer A. King

Objective. To identify physician and practice characteristics that are markers of success for meaningful use of electronic health records (EHRs).

Data Sources. American Medical Association survey, Centers for Medicare & Medicaid Services' (CMS) EHR Incentive, Pioneer Accountable Care Organization, and PECOS Programs, the Office of the National Coordinator for Health IT's Regional Extension Center Program, and National Committee for Quality Assurance Patient-centered Medical Home certification program.

Study Design. Retrospective analysis of 865,370 physicians' participation in CMS's EHR Incentive Program and progress to stage 1 Meaningful Use between 2011 and 2013. Physician specialty, age, practice size, geographic markers, delivery reform participation, and technical assistance receipt were predictive elements.

Principal Findings. Medicaid physicians were progressing more slowly to Meaningful Use than Medicare physicians: by 2013, 8 in 10 physicians registered with Medicare had achieved meaningful use, compared to one-third of Medicaid-registered physicians. The strongest predictors of meaningful use were technical assistance (79 percent more likely) and delivery reform participation (34 percent more likely).

Conclusions. Continued outreach and technical assistance that demonstrates strong interactions between meaningful use of health IT and delivery reform may facilitate further adoption of both initiatives.

Key Words. Health IT, delivery reform, disparities, electronic health record

When the Health Information Technology for Economic and Clinical Health (HITECH) Act was passed in 2009 (Health Information Technology for Economic and Clinical Health (HITECH) Act, 2009), less than half of office-based physicians had any electronic health record (EHR) system (Hsiao and Hing 2014). Five years later, the percentage of physicians with any EHR had increased to 78 percent. This growth is likely due in part to the Medicare and Medicaid EHR Incentive Program (Incentive Program) (Centers for Medicare

& Medicaid Services 2010); a majority of physicians who were new EHR adopters during this time period reported that financial incentives or penalties were a major influence on their decision to adopt an EHR (Jamoom et al. 2014).

The Incentive Program, created by the HITECH Act and initiated in 2011, was designed to promote the adoption and “meaningful use” of certified EHR technology to improve health care delivery and population health (Blumenthal and Tavenner 2010). The Incentive Program is designed around three progressive stages. Stage 1 requires eligible professionals to meet all 14 core measures and 5 of 10 menu measures (Centers for Medicare & Medicaid Services 2010), which focus on capturing relevant clinical data electronically. Subsequent stages of meaningful use focus on electronic exchange of those data and more advanced care processes using certified health information technology (IT). Meaningful use measures are grounded in improving performance in key aspects of health care, including patient engagement, privacy and security of sensitive health information, public health reporting, care coordination, and improvements in quality, safety, and efficiency.

If they meet eligibility requirements, professionals may participate in either the Medicare or Medicaid Incentive Programs. The Medicare Incentive Program is open to professionals who see Medicare patients and are not hospital-based. The Medicaid Incentive Program is open to professionals who serve a relatively large number of Medicaid patients: at least 30 percent of their services must be provided to Medicaid patients (20 percent for pediatricians). In recognition that Medicaid-eligible professionals may face additional resource challenges with EHR adoption, these providers may receive funds in their first year of the Incentive Program for adopting, implementing, or upgrading (AIU) certified EHR technology; in subsequent years of the program, these providers must demonstrate Meaningful Use to receive incentive payments. In contrast, Medicare eligible providers must demonstrate Meaningful Use in the first year.

Conceptual and empirical work has demonstrated that health IT adoption and use is correlated with organizational factors such as resource availability (including time and financial resources) and culture for innovation and change (Simon et al. 2007; McGinn et al. 2011). This study assesses the extent

Address correspondence to Dawn M. Heisey-Grove, M.P.H., U.S. Department of Health and Human Services, Office of the National Coordinator for Health IT, 330 C Street, SW, Mail Stop 7033A, Washington, DC 20201; e-mail: dawn.heisey-grove@hhs.gov. Jennifer A. King, Ph.D., is with the Aledade, Inc., Bethesda, MD.

to which these factors are associated with physician progress toward Meaningful Use. Specifically, we hypothesize that practicing in resource-constrained settings—small, independent practices and underserved settings—is associated with a lower likelihood of achieving Meaningful Use. On the other hand, we hypothesize that receipt of technical assistance designed to mitigate resource constraints and participation in other delivery system innovations are positively associated with the likelihood of achieving Meaningful Use.

Prior studies have examined the relationship between these organizational factors and EHR adoption. Studies consistently have shown solo or small group practice providers are slower to adopt EHRs than physicians in larger practices (Sowmya et al. 2011; Decker, Jamoom, and Sisk 2012; Xierali et al. 2013; Furukawa et al. 2014). The evidence is less consistent regarding a “digital divide” for physicians who serve vulnerable patient populations. Some recent national studies have found no differences in EHR adoption by the racial or ethnic composition of physicians’ patients (DesRoches, Painter, and Jha 2014) or county-level poverty rates (Chun-Ju et al. 2013), and most recent national studies have found that physicians in rural areas have EHR adoption rates comparable to physicians in urban areas (Xierali et al. 2013; Furukawa et al. 2014). However, other studies have found lower EHR adoption among physicians who serve large proportions of older patients (Yeager, Menachemi, and Brooks 2010) and have found geographic disparities in EHR adoption, with lower adoption in medically underserved geographic areas (Xierali et al. 2013) and areas with high concentrations of low-income and minority populations (King, Furukawa, and Buntin 2013).

Technical assistance designed to overcome these resource barriers may mitigate some of these differences in EHR adoption according to organizational characteristics (Torda, Han, and Scholle 2010). For example, the Office of the National Coordinator for Health Information Technology’s (ONC) Regional Extension Center (REC) program prioritizes technical assistance to small practices and community and rural health centers (Maxson et al. 2010; Lynch et al. 2014). The technical assistance offered through ONC’s RECs focused on EHR adoption and Meaningful Use achievement. As a result, providers receiving assistance from ONC’s REC program were significantly more likely to participate and progress through the Incentive Program than nonenrolled providers (U.S. Government Accountability Office, 2012).

Moreover, participation in other health care delivery system innovations may also be a driver of health IT adoption and use, both as a marker of innovation culture and because health IT is often an explicit component of delivery reform efforts such as patient-centered medical homes (PCMH) and

accountable care organizations (ACO) (Burton, Devers, and Berenson 2012; Colla et al. 2014). Examples of regional implementations of delivery reform include the Beacon Community program (Allen et al. 2014) and CMS's State Innovation Model (SIM) (Centers for Medicare & Medicaid Services, n.d.). The Beacon Community program applied health IT innovations within communities to improve population health; recipients of CMS's SIM Testing grants focus on statewide collaborative efforts to enact health care delivery and payment reform. Care coordination, health information exchange, and easy retrieval of patient information are key components of all of these delivery reform models. Because of the alignment between the delivery reform models' goals and the Incentive Program, providers participating in these models may be quicker to adopt and meaningfully use EHRs.

This study presents a summary of the first 3 years of the Incentive Program with two main goals: describe physicians' initial progress to and ongoing achievement of Meaningful Use; and determine whether disparities in Meaningful Use achievement exist according to organizational factors associated with EHR adoption in the past.

METHODS

Study Population

The analysis population included all ambulatory care physicians in the United States, excluding U.S. territories. All physicians from the 2011 American Medical Association (AMA) Physician MasterFile, data from the CMS Incentive Program, and ONC REC enrollment files were included in the final analysis dataset; only physicians with addresses outside the United States were excluded. The CMS Incentive Program data file included demographic, registration, and payment specifics for all providers who registered with or who were paid by either branch of the Incentive Program (Medicare or Medicaid). Details on provider Meaningful Use attestations were only available for Medicare providers. Demographic information was available through the ONC REC files on all providers enrolled with an ONC REC program.

Data were merged using providers' National Provider Identifier (NPI). The final analysis file included 865,370 physicians.

Outcomes

This study had five measured outcomes.

To assess initial progress to Meaningful Use, four dichotomous variables were used: whether the physician had registered to participate in the Incentive Program; whether the physician had ever received a payment from Medicaid to AIU-certified EHR technology; and whether the physician ever had achieved Meaningful Use through either Medicaid or Medicare. Registration with the Incentive Program was used as a marker of intent to participate in the Incentive Program, but on its own, should not imply that the physicians had adopted health IT or achieved Meaningful Use. An AIU payment indicated that the physician intended to implement, or had already implemented or upgraded to, certified health IT, a necessary component of achieving Meaningful Use. Finally, Meaningful Use was achieved when the provider attested to having met the minimum thresholds on the stage 1 Meaningful Use measures while using certified health IT.

To assess ongoing achievement of Meaningful Use, physicians who demonstrated Medicare Meaningful Use in either 2011 or 2012 were tracked to determine whether they skipped Meaningful Use achievement in subsequent years. Physicians who skipped one or more years after first achieving Meaningful Use were categorized as having skipped using a dichotomous variable.

Independent Variables

We analyzed key independent variables to identify drivers and disparities in Meaningful Use achievement. Drivers and disparities were grouped into three categories: physician and practice characteristics, area characteristics, and technical assistance and delivery reform participation.

Physician and Practice Characteristics. Physician and practice characteristics included physician age, specialty, and practice size.

Physician age was based primarily on the AMA Masterfile. If age was not available from that dataset, information from the PECOS file was used. Practice size was determined by counting the number of providers associated with the physician's billing NPI in PECOS.

Physician specialty was grouped into five categories: behavioral health, nondirect patient care, medical/surgical, dual specialists (medical/surgical and primary care), and primary care only. The classification was based on information from the AMA Masterfile, Incentive Program, and ONC REC datasets. Physicians noted in any of the datasets to have a behavioral health or

nondirect patient care specialty were classified as such. Physicians without a primary care specialty (family or internal medicine, pediatrics, geriatrics, adolescent medicine, obstetrics, and gynecology) in any of the datasets were categorized as having a medical/surgical specialty.

Area Characteristics. Area characteristics were based on the 2012 Health Resources and Services Administration Area Health Resources File and CMS's 2014 Primary Care Health Professional Shortage Areas (HPSA) designations (US Department of Health and Human Services, n.d.). Area characteristics included county-level rural–urban designation and demographics including the percent of the population that was Hispanic, African American, in poverty, or over 65 years of age. Physicians in nonmetropolitan counties were classified as rural. Primary care HPSAs were based on zip code–level designations from CMS.

Technical Assistance and Delivery Reform Participation. Receipt of technical assistance was measured by enrollment with an ONC REC. Delivery reform participation included NCQA PCMH certification, Pioneer ACO participation, and practice location in a Beacon Community Program catchment area or CMS State Innovation Model (SIM) Testing state.

Participation in PCMH and REC programs was based on activity through July 2014. All providers located in the Beacon Community zip codes were considered Beacon participants for these analyses. Physicians were tagged as SIM participants if they were located in states that received first-round Model Testing Awards from CMS (Arkansas, Maine, Massachusetts, Minnesota, Oregon, and Vermont) (Centers for Medicare & Medicaid Services, n.d.).

Analytic Methods

Adjusted relative risks were calculated using a Poisson regression with a robust variance estimate (Greenland 2004; Zou 2004; Spiegelman and Hertzmark 2005; Kleinman and Norton 2009). Individual regressions were performed for each outcome measured.

To assess initial progress to Meaningful Use, we estimated four regression models. The first model assessed factors associated with Incentive Program registration among all U.S. office-based physicians ($n = 634,621$). The

next three models examined progress to AIU and Meaningful Use among physicians registered for the Incentive Programs. Because the Medicare and Medicaid Programs have different eligibility and progress milestones, separate models were estimated to assess progress within each arm of the Incentive Program. For Medicaid Incentive Program-registered physicians, we estimated two models to assess factors associated with receiving AIU payment and achieving Meaningful Use ($n = 74,565$). For physicians registered with the Medicare Incentive Program, we estimated one model that assessed factors associated with achieving Meaningful Use ($n = 286,377$).

To assess factors associated with ongoing achievement of Meaningful Use, we created a model that estimated the risk of skipping a subsequent Meaningful Use year among physicians who first achieved Meaningful Use in 2011 or 2012 ($n = 175,750$).

Independent variables in all models included the measures of physician and practice characteristics, area characteristics, receipt of technical assistance, and participation in delivery reform activities describe above. All calculations were performed using SAS version 9.3.

We conducted sensitivity analyses to assess the impact of decisions made in the analytic file creation on our findings. The main analysis sample described above included physicians who were present in the AMA Masterfile, the Medicare or Medicaid EHR Incentive Programs data, or the ONC REC data. We also conducted all analyses on a dataset that included only physicians in the AMA Masterfile; there were no substantive differences between these results and the main results.

RESULTS

Initial Progress to Meaningful Use

Registration. Almost half of all physicians (47 percent) were registered with the Incentive Program (Table 1).

Registration rates were lowest among physicians with behavioral health (27 percent) and nondirect patient care specialties (27 percent) and highest among primary care (55 percent) and dual specialty physicians (57 percent). Solo practice practitioners had a lower registration rate (40 percent) than physicians in larger practices (ranging from 54 to 62 percent). In multivariate analyses, physician specialty, practice size, and technical assistance and delivery reform participation had the strongest associations with Incentive Program registration. Physicians receiving technical assistance from an REC

Table 1: Incentive Program Registration Rates among Office-Based Physicians

	<i>Prop. of Total Population, % (n = 865,370)</i>	<i>Registered with Incentive Program, % (n = 404,271)</i>	<i>Relative Risk</i>	<i>95% Confidence Interval</i>
<i>Provider/practice characteristics</i>				
Physician age				
45 or under	39	46	1.044	1.039, 1.049
46 to 55	25	54	1.097	1.092, 1.102
56 or older	35	42	Ref	Ref
Physician specialty				
Behavioral health	6	27	0.724	0.709, 0.738
Nondirect patient care	14	27	0.583	0.573, 0.593
Medical/surgical	28	47	1.068	1.062, 1.074
Dual specialty (primary care and medical/surgical)	16	57	1.043	1.038, 1.049
Primary care	33	55	Ref	Ref
Practice size				
51+ providers	39	61	1.493	1.484, 1.502
11–50 providers	15	54	1.377	1.367, 1.387
6–10 providers	4	62	1.513	1.502, 1.524
2–5 providers	7	59	1.426	1.415, 1.437
Solo practice	9	40	Ref	Ref
<i>Geography and disparity metrics</i>				
Rural/urban				
Rural	8	53	0.934	0.926, 0.941
Metro	91	46	Ref	Ref
Primary care health professional shortage area (HPSA)				
Yes	2	52	1.010	0.997, 1.023
No	98	47	Ref	Ref
Percent of population in county that is Hispanic				
19+%	33	43	0.924	0.918, 0.930
6–18%	35	47	0.982	0.978, 0.987
<6%	32	50	Ref	Ref
Percent of population in county that is black/African American				
17+%	34	44	0.946	0.940, 0.951
6–16%	35	45	0.948	0.943, 0.954
<6%	31	52	Ref	Ref
Percent of population in county that is over 65 years old				
>14%	31	49	0.948	0.942, 0.953
11–13%	35	45	0.960	0.955, 0.965
<11%	33	47	Ref	Ref

Continued

Table 1. *Continued*

	<i>Prop. of Total Population, % (n = 865,370)</i>	<i>Registered with Incentive Program, % (n = 404,271)</i>	<i>Relative Risk</i>	<i>95% Confidence Interval</i>
Percent of population in county that is living in poverty				
18+%	37	45	1.015	1.009, 1.021
14–17	31	48	1.044	1.038, 1.049
<14%	32	48	Ref	Ref
<i>Delivery reform and technical assistance programs</i>				
Patient-centered medical home (PCMH) certification				
Yes	3	89	1.251	1.246, 1.257
No	97	45	Ref	Ref
Regional extension center (REC) technical assistance				
Yes	13	87	1.590	1.586, 1.594
No	87	41	Ref	Ref
Pioneer accountable care organization (ACO) participant				
Yes	2	75	1.221	1.212, 1.229
No	98	46	Ref	Ref
State innovation model (SIM) testing state				
Yes	8	54	1.028	1.021, 1.035
No	91	46	Ref	Ref
Beacon community program area				
Yes	7	49	1.001	0.993, 1.009
No	93	47	Ref	Ref

Notes. These results describe the characteristics of physicians who registered to participate in the Centers for Medicare & Medicaid Services’ EHR Incentive Program. Estimates based on Poisson regression with robust variance estimate, using the Centers for Medicare & Medicaid Services EHR Incentive Program registration data from 2011 to 2013 and physician and practice characteristics from a variety of sources.

were 59 percent (RR = 1.590, CI = 1.586–1.594) more likely to be registered with the Incentive Program than those not working with an REC. Delivery reform participants also had relatively high registration rates, particularly physicians participating in PCMH (RR = 1.251, CI = 1.246–1.257) or ACO (RR = 1.221, CI = 1.212–1.229) activities.

Other physician and area characteristics were associated with Incentive Program registration, but differences were smaller in magnitude. Physician age was negatively associated with registration rates; for example, physicians between the ages of 46–55 years were 10 percent more likely to be registered than physicians aged 56 or older (RR = 1.097, CI = 1.092–1.102). There were also modest differences in registration rates by key geographic characteristics. More than half of physicians in rural counties were registered (53 percent compared to 46 percent in urban counties); however, when controlling for

other characteristics, they were 7 percent less likely to be registered compared to physicians in urban counties (RR = 0.934, CI = 0.926, 0.941). Physicians in counties with higher concentrations of Hispanic (RR = 0.924, CI = 0.918–0.930), black/African American (RR = 0.946, CI = 0.940–0.951), and older populations (RR = 0.948, CI = 0.942–0.953) were less likely to be registered than other physicians.

AIU and Meaningful Use Achievement among Medicaid Participants. Among physicians registered for the Medicaid Incentive Program, 83 percent had received incentive payment for AIU to a certified EHR system (Table 2). In general, differences in AIU achievement by physician characteristics were small. The strongest predictor of AIU achievement was receipt of technical assistance from an REC (RR = 1.144, CI = 1.137–1.151).

About a third of physicians registered for the Medicaid Incentive Program had achieved Meaningful Use (34 percent). There was substantial variation in Meaningful Use achievement by physician specialty: behavioral health and nondirect patient care physicians were 56 percent (RR = 0.444, CI = 0.381–0.507) and 53 percent (RR = 0.473, CI = 0.402–0.544) less likely to have achieved Meaningful Use than primary care physicians. There were some differences in Meaningful Use achievement by area characteristics; most notable was that in multivariate analyses physicians in counties with high concentrations of Hispanic population were 31 percent less likely to have achieved Meaningful Use relative to physicians in counties with low Hispanic population (RR = 0.688, CI = 0.662–0.714). Physicians participating in delivery system reform were substantially more likely to have achieved Meaningful Use than other physicians. Similar to previous results, the strongest predictor of Meaningful Use achievement was receipt of technical assistance from an REC; REC participants were 79 percent more likely to have achieved Meaningful Use than nonparticipants (RR = 1.789, CI = 1.768–1.810).

Meaningful Use Achievement among Medicare Participants. Over 8 in 10 physicians (83 percent) registered with the Medicare EHR Incentive Program had achieved Meaningful Use. Of the key characteristics examined, physician specialty, technical assistance, and delivery reform participation had the strongest associations with Meaningful Use achievement. In adjusted analyses, physicians with behavioral health and nondirect patient care specialties were 16 percent (RR = 0.837, CI = 0.818–0.855) and 28 percent (RR = 0.725,

Table 2: Medicaid Adopt-Implement-Upgrade (AIU) and Meaningful Use Payment Rates among Office-Based Physicians Registered with the Medicaid Incentive Program

	Percent of Medicaid-Registered Physicians (n = 101,796)	Paid to Adopt-Implement-Upgrade (AIU) (n = 84,406)			Achieved Meaningful Use (MU) (n = 35,058)		
		Percent	RR	95% CI	Percent	RR	95% CI
Provider/practice characteristics							
Physician age							
45 or under	39	82	0.984	0.976, 0.992	34	1.007	0.985, 1.029
46 to 55	26	85	1.000	0.991, 1.008	38	1.076	1.052, 1.099
56 or older	31	84	Ref	Ref	34	Ref	Ref
Physician specialty							
Behavioral health	8	76	0.967	0.953, 0.982	13	0.444	0.381, 0.507
Nondirect patient care	5	80	1.009	0.993, 1.025	14	0.473	0.402, 0.544
Medical/surgical	12	81	1.021	1.009, 1.033	29	1.056	1.022, 1.089
Primary care and medical/surgical	18	85	1.020	1.011, 1.029	37	1.056	1.032, 1.080
Primary care	54	85	Ref	Ref	41	Ref	Ref
Practice size							
51+ providers	46	85	1.047	1.032, 1.061	36	1.089	1.051, 1.128
11–50 providers	14	85	1.042	1.026, 1.058	35	0.982	0.940, 1.024
6–10 providers	3	84	1.025	1.004, 1.046	35	0.941	0.883, 0.999
2–5 providers	4	82	1.004	0.984, 1.024	35	0.990	0.937, 1.042
Solo practice	5	81	Ref	Ref	33	Ref	Ref

Continued

Table 2. *Continued*

	Percent of Medicaid-Registered Physicians (n = 101,796)	Paid to Adopt-Implement-Upgrade (AIU) (n = 84,406)			Achieved Meaningful Use (MU) (n = 35,058)		
		Percent	RR	95% CI	Percent	RR	95% CI
Geography and disparity metrics							
Rural/urban							
Rural	12	85	0.997	0.986, 1.009	41	0.982	0.952, 1.012
Metro	88	83	Ref	Ref	33	Ref	Ref
Primary care health professional shortage area (HPSA)							
Yes	4	81	0.945	0.926, 0.964	36	0.955	0.909, 1.000
No	96	83	Ref	Ref	34	Ref	Ref
Percent of population in county that is Hispanic							
19+%	35	80	0.946	0.937, 0.956	29	0.688	0.662, 0.714
6–18%	32	83	0.982	0.973, 0.990	34	0.898	0.875, 0.921
<6%	33	85	Ref	Ref	40	Ref	Ref
Percent of population in county that is black/African American							
17+%	38	83	1.017	1.007, 1.027	33	0.993	0.966, 1.020
6–16%	30	83	1.035	1.026, 1.045	32	0.954	0.929, 0.980
<6%	32	83	Ref	Ref	38	Ref	Ref
Percent of population in county that is over 65 years old							
>14%	31	84	0.967	0.957, 0.977	39	1.019	0.993, 1.046
11–13%	34	82	0.958	0.949, 0.966	35	1.058	1.034, 1.081
<11%	35	83	Ref	Ref	30	Ref	Ref
Percent of population in county that is living in poverty							
18+%	46	83	1.027	1.017, 1.037	33	1.045	1.017, 1.073
14–17	30	83	0.994	0.984, 1.004	37	1.132	1.105, 1.158
<14%	24	83	Ref	Ref	34	Ref	Ref

Continued

Table 2. Continued

	Percent of Medicaid-Registered Physicians (n = 101,796)	Paid to Adopt-Implement-Upgrade (AIU) (n = 84,406)			Achieved Meaningful Use (MU) (n = 35,058)		
		Percent	RR	95% CI	Percent	RR	95% CI
Delivery reform and technical assistance programs							
Patient-centered medical home (PCMH) certification							
Yes	9	91	1.074	1.065, 1.083	58	1.341	1.317, 1.365
No	91	82	Ref	Ref	32	Ref	Ref
Regional extension center (REC) technical assistance							
Yes	37	91	1.144	1.137, 1.151	52	1.789	1.768, 1.810
No	63	78	Ref	Ref	24	Ref	Ref
Pioneer accountable care organization (ACO) participant							
Yes	3	84	0.950	0.930, 0.971	46	1.301	1.257, 1.345
No	97	83	Ref	Ref	34	Ref	Ref
State innovation model (SIM) testing state							
Yes	10	87	1.048	1.038, 1.058	40	1.137	1.109, 1.164
No	90	82	Ref	Ref	34	Ref	Ref
Beacon community program area							
Yes	6	84	0.997	0.983, 1.011	40	0.965	0.928, 1.001
No	94	83	Ref	Ref	34	Ref	Ref

Notes. These results describe the characteristics associated with physicians progressing through the Medicaid EHR Incentive Program. Step 1 is adopted, implement, or upgrade to certified health IT; next is to attest to meeting the minimum threshold for a set of measures designed to assess “meaningful use” of certified health IT. Estimates based on Poisson regression with robust variance estimate, using Medicaid EHR Incentive Program payment data from 2011 to 2013 and physician and practice characteristics from a variety of sources. RR = Relative Risk; CI = Confidence Interval. Percent for the two payment categories is the unadjusted percent of Medicaid-registered providers who have been paid for each milestone (AIU and MU).

CI = 0.715–0.736) less likely to have achieved Meaningful Use than primary care physicians. With regard to technical assistance and delivery reform participation, the strongest predictors of Meaningful Use achievement were PCMH participation (RR = 1.122, CI = 1.118–1.126) and receipt of REC technical assistance (RR = 1.133, CI = 1.129–1.136).

There were statistically significant associations between Meaningful Use achievement and other practice and area characteristics in multivariate analyses. However, the magnitude of these associations was smaller.

Ongoing Achievement of Meaningful Use

Among Medicare Incentive Program physicians who started the program in 2011 or 2012, 17 percent skipped at least one subsequent year of the Incentive Program. Physicians who skipped the second year of the program were almost 5 times more likely to also skip the third year of the program; 9 percent of the physicians who first attested in 2011 skipped both 2012 and 2013.

Behavioral health specialists had higher rates of skipping in subsequent years of the program (RR = 1.254, CI = 1.175–1.332) (Table 3). Physicians in solo practices were also more likely to skip subsequent years of the program. Among the geographic-based variables, physicians in a rural county (RR = 1.130, CI = 1.093–1.167), who service in a primary care HPSA (RR = 1.219, CI = 1.155–1.284), or were located in a county with higher Hispanic populations (RR = 1.171, CI = 1.142–1.199), were most likely to skip a Meaningful Use year. Among these, providing care in a primary care HPSA was the strongest predictor: these physicians were 22 percent more likely to skip a year of Meaningful Use after starting the program, compared to other physicians. Participation in the Pioneer ACO program (RR = 0.838, CI = 0.782–0.894), location in a SIM testing state (RR = 0.916, CI = 0.877–0.955), and PCMH certification (RR = 0.582, CI = 0.524–0.640) were markers for participation in all subsequent years.

DISCUSSION

Three years into the Medicare and Medicaid EHR Incentive Programs, physicians were making significant progress toward the adoption and Meaningful Use of EHRs. Almost half of all physicians had registered to participate in the Incentive Programs, indicating intent to adopt EHRs and use them in a meaningful way to enhance patient care. Once registered, over 8 in 10 physicians

Table 3: Medicare Meaningful Use Achievement and Progress among Office-Based Physicians Registered with the Medicare Incentive Program

	Percent of Medicare-Registered Physicians (n = 301,022)	Achieved Meaningful Use (MU) (n = 250,516)			Skipped Year	
		Percent	RR	95% CI	RR	95% CI
Provider/practice characteristics						
Physician age						
45 or under	38	83	1.004	1.000, 1.008	0.979	0.954, 1.004
46 to 55	29	85	1.025	1.021, 1.029	0.886	0.860, 0.911
56 or older	32	83	Ref	Ref	Ref	Ref
Physician specialty						
Behavioral health	2	69	0.837	0.818, 0.855	1.254	1.175, 1.332
Nondirect patient care	9	60	0.725	0.715, 0.736	0.988	0.940, 1.037
Medical/surgical	34	85	1.035	1.030, 1.039	0.844	0.817, 0.872
Primary care and medical/surgical	20	85	1.015	1.010, 1.019	0.911	0.882, 0.940
Primary care	34	88	Ref	Ref	Ref	Ref
Practice size						
51+ providers	52	83	1.033	1.027, 1.040	0.593	0.560, 0.625
11–50 providers	18	84	1.046	1.038, 1.052	0.709	0.673, 0.745
6–10 providers	7	87	1.061	1.053, 1.069	0.783	0.739, 0.827
2–5 providers	10	85	1.039	1.031, 1.047	0.900	0.862, 0.938
Solo practice	8	81	Ref	Ref	Ref	Ref

Continued

Table 3. *Continued*

	Percent of Medicare-Registered Physicians (n = 301,022)	Achieved Meaningful Use (MU) (n = 250,516)			Skipped Year	
		Percent	RR	95% CI	RR	95% CI
Geography and disparity metrics						
Rural/urban						
Rural	9	84	0.975	0.969, 0.981	1.130	1.093, 1.167
Metro	91	83	Ref	Ref	Ref	Ref
Primary care health professional shortage area (HPSA)						
Yes	2	85	1.020	1.008, 1.032	1.219	1.155, 1.284
No	98	83	Ref	Ref	Ref	Ref
Percent of population in county that is Hispanic						
19+%	28	82	1.007	1.002, 1.011	1.171	1.142, 1.199
6–18%	37	84	1.010	1.006, 1.013	0.990	0.965, 1.016
<6%	35	84	Ref	Ref	Ref	Ref
Percent of population in county that is black/African American						
17+%	30	82	0.990	0.985, 0.995	1.012	0.983, 1.041
6–16%	35	83	0.984	0.980, 0.989	1.046	1.019, 1.073
<6%	35	85	Ref	Ref	Ref	Ref
Percent of population in county that is over 65 years old						
>14%	33	85	1.008	1.003, 1.012	0.998	0.970, 1.027
11–13%	34	83	0.997	0.993, 1.001	0.981	0.954, 1.007
<11%	33	82	Ref	Ref	Ref	Ref
Percent of population in county that is living in poverty						
18+%	31	81	0.970	0.966, 0.975	1.048	1.019, 1.077
14–17	33	82	0.978	0.974, 0.982	0.976	0.950, 1.003
<14%	36	86	Ref	Ref	Ref	Ref

Continued

Table 3. Continued

	Percent of Medicare-Registered Physicians (n = 301,022)	Achieved Meaningful Use (MU) (n = 250,516)			Skipped Year	
		Percent	RR	95% CI	RR	95% CI
Delivery reform and technical assistance programs						
Patient-centered medical home (PCMH) certification						
Yes	5	97	1.122	1.118, 1.126	0.582	0.524, 0.640
No	95	82	Ref	Ref	Ref	Ref
Regional extension center (REC) technical assistance						
Yes	19	94	1.133	1.129, 1.136	0.977	0.950, 1.003
No	81	81	Ref	Ref	Ref	Ref
Pioneer accountable care organization (ACO) participant						
Yes	4	87	1.017	1.009, 1.024	0.838	0.782, 0.894
No	96	83	Ref	Ref	Ref	Ref
State innovation model (SIM) testing state						
Yes	9	87	1.034	1.028, 1.039	0.916	0.877, 0.955
No	91	83	Ref	Ref	Ref	Ref
Beacon community program area						
Yes	7	80	0.976	0.969, 0.983	1.051	1.008, 1.095
No	93	83	Ref	Ref	Ref	Ref

Notes. These results describe the characteristics associated with physicians progressing through the Medicare EHR Incentive Program. Physicians who achieved Meaningful Use attested to having met a set of measures designed to assess “meaningful use” of certified health IT. Providers who did not attest to Meaningful Use for every successive year following their first attestation were captured as having “skipped,” which was a dichotomous variable. Estimates based on Poisson regression with robust variance estimate, using Medicare EHR Incentive Program payment data from 2011 to 2013 and physician and practice characteristics from a variety of sources. RR = Relative Risk; CI = Confidence Interval; Percent = unadjusted percent of Medicare-registered providers who were paid for MU, or who skipped a subsequent year of MU payment.

had made progress to initial program milestones of AIU-certified EHR technology, or achieving Meaningful Use. The results of this study highlight key differences in progress to Meaningful Use and point to promising drivers of health IT adoption and use going forward.

Subsequent stages of the Incentive Program encourage more advanced use of certified health IT. For example, stage 2 includes measures that encourage eligible professionals to electronically exchange share patient health information with other providers during care transitions, as well as to engage patients to view, download, or transmit their electronic health information (Centers for Medicare & Medicaid Services 2012). Stage 3 may include higher performance thresholds for electronic information exchange and more advanced use of certified health IT (Centers for Medicare & Medicaid Services 2015). Physicians who were struggling to participate and progress through the first stage of Meaningful Use may require additional assistance to maintain their progress and to achieve those more advanced use goals.

One key set of findings regards progress to Meaningful Use among physicians in the Medicaid Incentive Program. A strong majority of these physicians had received payment to adopt, implement, or upgrade to certified health IT, progress that was uniform across most key physician and area characteristics. However, only one-third had gone on to achieve Meaningful Use, a much lower rate of Meaningful Use achievement than in the Medicare Incentive Program. This may be due in part to differences in the way the programs are structured: the adopt, implement, upgrade option does not exist in the Medicare Incentive Program; moreover, there is no penalty in the Medicaid program for skipping years. Thus, providers receiving Medicaid incentive payments may have less motivation to transition quickly to meaningful use of their EHRs after receiving the initial adopt, implement, or upgrade incentive. It is also possible that physicians serving larger proportions of Medicaid patients face additional or more significant barriers to achieving Meaningful Use. Going forward, understanding how to support Medicaid physicians in moving from the adoption and implementation phase to Meaningful Use will be important to ensuring equitable EHR use in this important provider population.

Another important finding, consistent with previous research, was that practice size and physician specialty were associated with progress to Meaningful Use. This study found that physicians in solo practice were lagging behind physicians in larger practices in Incentive Program participation and Meaningful Use. Most striking was that solo practice physicians were substantially less likely to be registered to participate in the Incentive Programs than

physicians in larger practices. This suggests that to date the biggest challenge for these very small practice physicians has been the initial decision and effort required to adopt and implement an EHR. It will be important to continue to target these small practice physicians in efforts designed to achieve universal EHR adoption across all physician groups.

We also found substantial differences by physician specialty in initial progress to, and ongoing achievement of, Meaningful Use. Compared to primary care and medical/surgical specialists, physicians specializing in behavioral health and nondirect patient care had much lower registration rates and lower rates of initial and ongoing Meaningful Use achievement after registration. Nondirect patient care physicians may have challenges meeting Incentive Program requirements which are mostly applicable to physicians directly interacting with patients; in response to these challenges, CMS introduced a hardship exception that allows physicians in these circumstances to avoid the payment adjustments that start in 2015 (Centers for Medicare & Medicaid Services 2012). Behavioral health specialists deal with a different set of challenges, focused primarily around the ability of health IT to adequately manage specific privacy and patient confidentiality requirements. Supporting health IT adoption among behavioral health specialists is a priority in the Federal Health IT Strategic Plan, and key stakeholders have identified several strategies that may help overcome these challenges (RTI International 2012; Federal Health Information Technology Strategic Plan 2011-2015 n.d.).

Although we observed some modest differences in initial and ongoing Meaningful Use achievement according to area characteristics, they tended to be much smaller in magnitude than differences by physician characteristics such as practice size and specialty. It will be critical to continue to monitor progress and to intervene if these gaps widen or persist. Trends within the regional delivery reform implementations (Beacon Community and SIM) varied. This may reflect the fact that not all physicians in the catchment area were participants in the program, which could shift the results toward the null.

Finally, we found that receipt of technical assistance from an ONC Regional Extension Center and participation in practice-level delivery reform initiatives were the strongest predictors of Meaningful Use progress across almost all of our outcomes. The ONC Regional Extension Centers are providing technical assistance with EHR adoption and Meaningful Use to primary care providers in small practices and other underserved settings across the U.S. REC assistance could partially explain the relatively high (unadjusted) rate of MU achievement among Medicaid physicians in rural areas: the REC

program has worked with more than half of all rural primary care providers and has a strong Medicaid-eligible population (Lynch et al. 2014).

The two practice-level delivery system programs examined here—NCQA PCMH certification and Pioneer ACO participation—contain features intentionally aligned with Meaningful Use. These findings provide some evidence of synergies between programs designed to support the adoption and use of health IT and efforts to improve the way health care is delivered more broadly. Continued outreach and technical assistance that demonstrates the strong interactions between Meaningful Use of health IT and delivery reform may facilitate further adoption of both types of initiatives.

Limitations

This work does have limitations. It is difficult to accurately determine the number of providers eligible for the incentive program: CMS estimates approximately 537,000 providers are eligible, and the Government Accountability Office estimates there are more than 600,000 eligible providers (Centers for Medicare & Medicaid Services 2010; U.S. Government Accountability Office 2012). The sample used in this study to estimate participation included more than 865,000 physicians, making it probable that some of the physicians included were not eligible for the Incentive Program. As a result, the analyses may underestimate participation among eligible physicians.

By examining progress among physicians, we analyzed the largest segment of the eligible provider population. It is likely, however, that the experience of other eligible provider types, as well as noneligible health care providers, will differ (Heisey-Grove et al. 2013).

Because ONC's REC program was based on helping providers achieve meaningful use of certified health IT, it is likely there is some self-selection bias among the providers participating in the program. That is, providers participating in ONC's REC program may have been predisposed to attempting to achieve meaningful use before receiving assistance from the program. It should be noted, however, that ONC's RECs enrolled 4 in 10 primary care providers, and within that group, more than half of all rural primary care providers (Lynch et al. 2014). This represents large portions of those populations and leaves less opportunity for such bias.

The delivery reform analyses did not capture all physicians participating in PCMH or ACO activities. Only NCQA PCMH-recognized physicians were included; other organizations provide PCMH recognition and physicians may also perform PCMH activities without a formal recognition

program. Recognition criteria vary widely across the certifying bodies (Burton, Devers, and Berenson 2012). NCQA purposefully designed their 2011 PCMH certification to align with stage 1 of Meaningful Use; therefore, physicians with this certification may be more likely to participate in the Incentive Program and perform better than physicians participating in other PCMH programs.

In addition to the Pioneer ACO, there are other, federal, state, and privately sponsored ACOs. The Pioneer ACO program requires that at least 50 percent of the organization's primary care providers have attested to Meaningful Use. Other ACOs may not have similar requirements. Thus, Pioneer ACO participants may not necessarily represent other ACO participants where the Meaningful Use requirement is not present.

CONCLUSION

In conclusion, we observed differences in physician participation and progress within the Incentive Program consistent with disparities previously reported around practice size and population served. Physicians participating in the Medicaid Incentive Program had strong adopt, implement, and upgrade rates, but, possibly due to differences in the program implementation compared to the Medicare Incentive Program, were not progressing to Meaningful Use.

Physicians with behavioral health and nondirect patient care specialties, solo practice physicians, physicians in rural areas, and those serving underserved areas may need additional assistance to make the transition to meaningful use.

Primary care physicians, physicians in larger practices, and physicians participating in delivery reform efforts show some of the strongest participation and Meaningful Use achievement rates. REC program participants also demonstrated significant achievement in these analyses.

ACKNOWLEDGMENTS

Joint Acknowledgment/Disclosure Statement: Staff from the Centers for Medicare and Medicaid Services (CMS), which provided some of the data for use by the authors, read and approved the manuscript, per the Data Use Agreement between CMS and the Office of the National Coordinator for Health Information Technology (ONC). Both ONC and CMS are part of the US Department

of Health and Human Services (HHS). At the time of this work was done, both authors were employees of ONC. All analyses were performed using datasets generated by CMS and HHS programs, or purchased by ONC. There were no sponsors, conflicts of interest, or financial or material support.

Disclosures: None.

Disclaimers: None.

REFERENCES

- Allen, A., T. R. Des Jardins, A. Heider, C. R. Kanger, D. F. Lobach, L. McWilliams, J. M. Polello, A. L. Rein, A. A. Schachter, R. Singh, B. Sorondo, M. C. Tulikangas, and S. A. Turske. 2014. "Making It Local: Beacon Communities Use Health Information Technology to Optimize Health Care." *Population Health Management* 17 (3): 149–58.
- Blumenthal, D., and M. Tavenner. 2010. "The "Meaningful Use" Regulation for Electronic Health Records." *The New England Journal of Medicine* 363 (6): 501–4.
- Burton, R. A., K. J. Devers, and R. A. Berenson. 2012. *Patient-Centered Medical Home Recognition Tools: A Comparison of Ten Suverys' Content and Operational Details*. Washington, DC: The Urban Institute.
- Centers for Medicare & Medicaid Services. 2010. "Medicare and Medicaid Electronic Health Record Incentive Program—Stage 1 Final Rule. 42 CFR Parts 412, 413, 422, and 495." *Federal Register* 75 (144): 44314–588.
- Centers for Medicare & Medicaid Services. 2012. "Medicare and Medicaid Programs; Electronic Health Record Incentive Program—Stage 2. 42 CFR Parts 412, 413, and 495." *Federal Register* 77 (171): 53968–4162.
- Centers for Medicare & Medicaid Services. 2015. "Medicare and Medicaid Programs; Electronic Health Record Incentive Program—Stage 3. 42 CFR Part 495. Proposed Rule." *Federal Register* 80 (60): 16732–804.
- Centers for Medicare & Medicaid Services. n.d. "State Innovations Model Design" [accessed on July 18, 2014]. Available at <http://innovation.cms.gov/initiatives/state-innovations-model-design/>
- Chun-Ju, H., A. K. Jha, J. King, V. Patel, M. F. Furukawa, and F. Mostashari. 2013. "Office-Based Physicians Are Responding to Incentives and Assistance by Adopting and Using Electronic Health Records." *Health Affairs* 32 (8): 1470–7.
- Colla, C. H., V. A. Lewis, S. M. Shortell, and E. S. Fisher. 2014. "First National Survey of ACOs Finds That Physicians Are Playing Strong Leadership and Ownership Roles." *Health Affairs* 33 (6): 964–71.
- Decker, S. L., E. W. Jamoom, and J. E. Sisk. 2012. "Physicians in Nonprimary Care and Small Practices and Those Age 55 and Older Lag in Adopting Electronic Health Record Systems." *Health Affairs* 31 (5): 1108–14.
- DesRoches, C. M., M. W. Painter, and A. K. Jha. 2014. "Health Information Technology in the United States: Progress and Challenges Ahead, 2014." *Robert Wood*

- Johnson Foundation [accessed on February 18, 2016]. Available at: <http://www.rwjf.org/content/dam/farm/reports/reports/2014/rwjf414891>
- Federal Health Information Technology Strategic Plan 2011-2015. n.d. Office of the National Coordinator for Health Information Technology.
- Furukawa, M. F., J. King, V. Patel, C.-J. Hsiao, J. Adler-Milstein, and A. K. Jha. 2014. "Despite Substantial Progress in EHR Adoption, Health Information Exchange and Patient Engagement Remain Low in Office Settings." *Health Affairs* 33 (9): 1672-9.
- Greenland, S. 2004. "Model-Based Estimation of Relative Risks and Other Epidemiologic Measures in Studies of Common Outcomes and in Case-Control Studies." *American Journal of Epidemiology* 160 (4): 301-5.
- Health Information Technology for Economic and Clinical Health (HITECH) Act. 2009. Title XIII of Division A and Title IV of Division B of the American Recovery and Reinvestment Act of 2009 (ARRA). Pub. L. No 111-5.
- Heisey-Grove, D. M., P. Klintworth, K. Tavernia, and K. Lynch. 2013. *Regional Extension Center Nurse Practitioners and Physician Assistants: Crucial Primary Care Providers on the Path to Meaningful Use*. ONC Data Brief, no. 11. Washington, DC: Office of the National Coordinator for Health Information Technology.
- Hsiao, C.-J., and E. Hing. 2014. *Use and Characteristics of Electronic Health Record Systems among Office-Based Physician Practices: United States, 2001-2013*. NCHS Data Brief, no 143. Washington, DC: Centers for Disease Control and Prevention.
- Jamoom, E. W., V. Patel, M. F. Furukawa, and J. King. 2014. "EHR Adopters vs. Non-Adopters: Impacts of, Barriers to, and Federal Initiatives for EHR Adoption." *Healthcare* 2: 33-9.
- King, J., M. F. Furukawa, and M. B. Buntin. 2013. "Geographic Variation in Ambulatory Electronic Health Record Adoption: Implications for Underserved Communities." *Health Services Research* 48 (6 Pt 1): 2037-59.
- Kleinman, L. C., and E. C. Norton. 2009. "What's the Risk? A Simple Approach for Estimating Adjusted Risk Measures from Nonlinear Models Including Logistic Regression." *Health Services Research* 44 (1): 288-302.
- Lynch, K., M. Kendall, K. Shanks, A. Haque, E. Jones, M. G. Wanis, M. Furukawa, and F. Mostashari. 2014. "The Health IT Regional Extension Center Program: Evolution and Lessons for Health Care Transformation." *Health Services Research* 49 (1 Pt 2): 421-37.
- Maxson, E., S. Jain, M. Kendall, F. Mostashari, and D. Blumenthal. 2010. "The Regional Extension Center Program: Helping Physicians Meaningfully Use Health Information Technology." *Annals of Internal Medicine* 153: 666-70.
- McGinn, C. A., S. Grenier, J. Duplantie, N. Shaw, C. Sicotte, L. Mathieu, Y. Leduc, F. Legare, and M. P. Gagnon. 2011. "Comparison of User Groups' Perspectives of Barriers and Facilitators to Implementing Electronic Health Records: A Systematic Review." *BMC Medicine* 9: 46.
- RTI International. 2012. *Behavioral Health Roundtable Summary of Findings*. Office of the National Coordinator for Health Information Technology [accessed on February 18, 2016]. Available at http://www.healthit.gov/sites/default/files/bh-roundtable-findings-report_0.pdf

- Simon, S. R., R. Kaushal, P. D. Cleary, C. A. Jenter, L. A. Volk, E. G. Poon, E. J. Orav, H. G. Lo, D. H. Williams, and D. W. Bates. 2007. "Correlates of Electronic Health Record Adoption in Office Practices: A Statewide Survey." *Journal of the American Medical Informatics Association* 14 (1): 110–7.
- Sowmya, R. R., C. M. DesRoches, K. Donelan, E. G. Campbell, P. D. Miralles, and A. K. Jha. 2011. "Electronic Health Records in Small Physician Practices: Availability, Use, and Perceived Benefits." *Journal of the American Medical Informatics Association* 18: 271–5.
- Spiegelman, D., and E. Hertzmark. 2005. "Easy SAS Calculations for Risk or Prevalence Ratios and Differences." *American Journal of Epidemiology* 162 (3): 199–200.
- Torda, P., E. S. Han, and S. H. Scholle. 2010. "Easing the Adoption and Use of Electronic Health Records in Small Practices." *Health Affairs* 29 (4): 668–75.
- US Department of Health and Human Services, Health Resources and Services Administration, Bureau of Health Professions. n.d. *Area Health Resources Files (AHRF) 2012-2013*. Rockville, MD: US Department of Health and Human Services.
- U.S. Government Accountability Office. 2012. *Number and Characteristics of Providers Awarded Medicare Incentive Payments for 2011*. Publication no. GAO-12-778R [accessed on February 18, 2016]. Available at: <http://www.gao.gov/assets/600/593078.pdf>
- Xierali, I. M., R. L. Phillips, L. A. Green, A. W. Bazemore, and J. C. Puffer. 2013. "Factors Influencing Family Physician Adoption of Electronic Health Records (EHRs)." *Journal of the American Board of Family Medicine* 26 (4): 388–93.
- Yeager, V. A., N. Menachemi, and R. G. Brooks. 2010. "EHR Adoption among Doctors Who Treat the Elderly." *Journal of Evaluation in Clinical Practice* 16: 1103–7.
- Zou, G. 2004. "A Modified Poisson Regression Approach to Prospective Studies with Binary Data." *American Journal of Epidemiology* 159 (7): 702–6.

SUPPORTING INFORMATION

Additional supporting information may be found in the online version of this article:

Appendix SA1: Author Matrix.