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RESEARCH ARTICLE

Improving Care Transitions Management: Examining the Role of Accountable Care Organization Participation and Expanded Electronic Health Record Functionality

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Objective. Examine the extent to which physician organization participation in an accountable care organization (ACO) and electronic health record (EHR) functionality are associated with greater adoption of care transition management (CTM) processes.

Data Sources/Study Setting. A total of 1,398 physician organizations from the third National Study of Physician Organization survey (NSPO3), a nationally representative sample of medical practices in the United States (January 2012–May 2013).

Study Design. We used data from the third National Study of Physician Organization survey (NSPO3) to assess medical practice characteristics, including CTM processes, ACO participation, EHR functionality, practice type, organization size, ownership, public reporting, and pay-for-performance participation.

Data Collection/Extraction Methods. Multivariate linear regression models estimated the extent to which ACO participation and EHR functionality were associated with greater CTM capabilities, controlling for practice size, ownership, public reporting, and pay-for-performance participation.

Principal Findings. Approximately half (52.4 percent) of medical practices had a formal program for managing care transitions in place. In adjusted analyses, ACO participation ($p < .001$) and EHR functionality ($p < .001$) were independently associated with greater use of CTM processes among medical practices.

Conclusions. The growth of ACOs and similar provider risk-bearing arrangements across the country may improve the management of care transitions by physician organizations.

Key Words. Care transitions, accountable care organizations, electronic health records, public reporting, pay-for-performance

Many medical care transitions occur throughout the health care delivery system and can involve complex coordination among providers and patients, that is, provider to provider transitions, inpatient to outpatient transitions, and in-hospital transitions (Arora and Farnan 2008). Managing care transitions from inpatient to outpatient settings is critical to improving patient outcomes and reducing cost, but little is known about the organizational characteristics of physician practices that can promote or deter the effective management of hospital to outpatient care transitions. About half of adults in the United States experience a medical error after a hospital discharge and 19–23 percent suffer an adverse event, most often related to a drug event occurring during inpatient to outpatient care transitions (Kripalani et al. 2007). Harmful and costly hospital readmissions resulting from poor care transitions are increasingly scrutinized by U.S. payers and policy makers to promote quality and efficiency while reducing total costs of care (Bisognano and Boutwell 2009). Better management of care transitions is particularly important for the growing number of adults with multiple chronic illnesses (Vogeli et al. 2007).

Previous research underscores the challenges of implementing and sustaining new organizational processes to support inpatient to outpatient care transitions (Kripalani et al. 2014). As more physician practices participate in federal and commercial accountable care organizations (ACOs), assessing the extent to which ACO participation supports the development and use of care transition processes among medical practices is an important area for investigation. The literature on care transitions management (CTM) programs is extensive and many intervention programs have been developed; for example, Care Transition Intervention (Coleman et al. 2006); Transitional Care Model (Naylor 2006); Project RED (Altfeld et al. 2013); and Project BOOST (Hansen et al. 2013). Each of these bundled interventions includes one or more of the following components: care coordinator roles, continuity of care between hospital and home, patient engagement, multidisciplinary care approach, collaboration and communication, follow-up visits, medication reconciliation, electronic information exchanges, early warning systems, and care coordination and discharge planning (Hesselink et al. 2012). Evidence is still accumulating about structures and processes to improve the

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management of care transitions; however, little is known about organizational factors that promote the development of CTM processes.

ACOs are increasingly held accountable for the cost and quality of care delivered to a defined group of patients (Shortell et al. 2014b). ACOs structure financial incentives so that participating medical practices and hospitals invest in developing and improving CTM processes. Recent estimates indicate that there are more than 700 ACOs nationally and they are in almost in every state with about 55 percent of people living in geographic areas with an active ACO (Muhlestein 2015). Roughly half of ACOs are public, with three different initiatives launched by the Center for Medicare and Medicaid (CMS)—a Pioneer program, shared savings program, and an advanced payment model (Shortell et al. 2015). Prior studies have shown that ACOs may improve quality and cost (Song et al. 2012; McWilliams et al. 2014), increase teamwork, and promote the adoption of electronic health information (Shortell et al. 2014a). Many consider the ability to coordinate care effectively through the use of care management processes and programs as central to achieving such results (Berwick 2011). We examine the association of ACO participation and electronic health record functionality with the use of CTM processes by medical practices, controlling for practice type, size, public reporting, and pay-for-performance participation. Moreover, we explore the potential mediating role of EHR functionality in explaining the relationship between ACO participation and greater use of CTM processes. Examining these relationships contributes to the literature on the management of inpatient to outpatient care transitions by highlighting the organizational factors that may promote or impede the development of CTM capabilities.

Medical practices participating in an ACO are more likely to be large in size, owned by physicians, use team-based care, have more primary care providers relative to specialists, and more likely to participate in public reporting and pay-for-performance programs (Shortell et al. 2014a). Controlling for these variables, we hypothesize that medical practices that participate in an ACO will have more CTM processes in place compared to practices that do not. Most CTM processes involve data analytic systems and/or electronic clinical information technology to manage patient transitions between the hospital and primary care practices (Hesselink et al. 2012). A high level of EHR functionality is central to implementing the Coleman transitional care model, which relies on strong electronic communication across settings of care (Coleman et al. 2006; Naylor 2006). In a systematic review, Hesselink and colleagues reviewed 36 major care transitions studies and found that 94.4 percent of these studies reported at least one electronic health record function to

facilitate more effective care transitions, including electronic patient summaries, discharge plans, electronic discharge notifications, and electronic patient information sharing between hospital and physicians (Hesselink et al. 2012). Given the preponderance and ubiquity of EHR functionality that enhances transitional care efforts of ACOs, we hypothesize that EHR functionality will mediate the positive association of ACO participation and medical practice use of CTM processes.

METHODS

Data

The data in this study use the third wave of the National Study of Physician Organizations (NSPO3) (Wiley et al. 2015). NSPO3 consisted of a 40-minute telephone survey of medical practices conducted between January 2012 and November 2013. The key respondents were either lead physicians or administrators most knowledgeable about the survey content in a nationally representative sample of physician practices and medical groups. Each of the participating respondents was paid \$200. Medical groups of less than 20 physicians were eligible if at least 40 percent of physicians in the group were primary care providers or specialists, including cardiologists, endocrinologists, or pulmonologists, given that the focus of the study was on patients with chronic illnesses, including asthma, congestive heart failure, depression, and diabetes. For medical groups of 20+ providers, at least 30 percent of physicians had to be primary care providers or specialists treating these conditions for study inclusion. The sample design was a stratified random sample of U.S. medical practices sampled from the IMS Health Care Organizational Services Database in May 2011. The survey response rate was 50 percent, yielding 1,398 practices for analysis. In the NSPO3 survey, population ratio-adjusted weights were determined based on sampling probabilities with poststratification adjustments. The weights were trimmed within primary sampling units based on the median plus three times the interquartile range, to avoid outliers that could adversely affect the results of the variances.

Dependent Variable

Care Transition Management (CTM) Processes. CTM processes were measured using a 7-point scale comprised of seven dichotomous “Yes versus No”

questions ($\alpha = 0.71$, range 0–7). Respondents were asked whether or not the practice had the following: (1) a formal care transitions program, and then asked whether the following CTM processes were in place; (2) physician notification by hospital within 2 hours after admitting patient to hospital; (3) physician notification by hospital within 2 hours after admitting patient to emergency department; (4) physician receipt of patient discharge summary within 48 hours from hospital; (5) physician receipt of patient discharge summary within 48 hours from emergency department; (6) patient contacted within 48 hours of hospital discharge (support services and schedule follow-up); (7) patient contacted within 48 hours of discharge for medication understanding/reconciliation.

Independent Variables

ACO Participation. Respondents were asked whether or not they belonged to an ACO. The ACO participation question had three response options: (1) participation in an ACO; (2) planning to participate within the next 12 months; and (3) do not belong and are not planning to participate in an ACO. For ease of interpretation, we created a binary ACO participation variable by combining “planning” and “do not belong” as not participating in an ACO.

EHR functionality was measured by a 14-item composite measure of EHR functionality ($\alpha = 0.89$, range 0–14) based on the sum of the 14 dichotomous questions that assessed whether a majority of physicians use the EHR for patient problem lists, progress notes, prompts, and reminders not specific to chronic conditions management, alerts for abnormal test results, electronic hospital discharge summaries at the main hospital, sending prescriptions directly to pharmacies, and communicating with patients via email. The 14-item EHR functionality includes functions consistent with Hesselink et al. (2012). Recent studies of ACOs have found that EHR functionality is positively associated with being part of an ACO (Shortell et al. 2014a; Wiley et al. 2015). To enable comparability with previously published research, we used the same variables to measure EHR functionality (Rodriguez et al. 2015; Wiley et al. 2015). The expanded EHR functionality measure also includes information technology processes highlighted in Naylor’s care transition intervention and Coleman’s transitional care model (Coleman et al. 2006; Naylor 2006). The Appendix describes each of the 14 items comprising the EHR functionality composite.

Control Variables

We control for internal practice capabilities and external incentives found to be associated with both ACO participation and greater EHR functionality in prior research (Rittenhouse et al. 2011; McClellan et al. 2013; Shortell et al. 2014a; Wiley et al. 2015). Specifically, care transitions between the hospital and physician practices may be influenced by the composition of primary care physicians versus specialists working in the practice. Specialists and primary care physicians may receive different admission and discharge information at different times, and multispecialty groups could also differ from each of these categories, so we controlled for practice type. We also controlled for practice size, ownership, public reporting, and pay-for-performance participation. Practice size may also be associated with care transitions, as larger practices have more resources to invest in care management and transition processes. Practice ownership may also influence care transition capabilities, as practices that belong to an HMO or integrated system could have more direct communication across organizational boundaries and more advanced health information technology capabilities. External incentives in the form of public reporting of patient satisfaction and quality and pay-for-performance participation may also incentivize practices to enhance their care transition capabilities as financial reimbursement is often tied to such outcome measures as readmissions (Shadmi et al. 2015).

Analysis

First, we examined response means and distributions for each of the seven CTM processes individually and then rank-ordered them from most used to least used. Bivariate analyses for each of the seven care transition items were analyzed, stratified by practices participating in an ACO versus practices not participating in an ACO. For these analyses, we used one-way ANOVA to examine the extent to which ACO participation, EHR functionality, practice type, organization size, ownership, public reporting, and pay-for-performance participation differed based on high, medium, and low categories of the CTM composite. Next, multivariate linear regression models estimated the relative association of ACO participation and EHR functionality, controlling for practice capabilities, external incentives. We used state-fixed effects to control for state-level policy differences that may shape ACO participation, EHR functionality, and use of CTM processes. Since our CTM composite measure is a count measure (range: 0–7), we estimated our multivariate model using

Poisson regression as a sensitivity analysis to assess the robustness of the main results with an alternative model specification. To examine the potential mediating impact of greater EHR functionality on the relation of ACO participation and greater CTM processes, we compared results of a model that included ACO but not EHR functionality (Model 1) and a model that included both ACO and EHR functionality (Model 2). We estimated the potential mediating effect by calculating the percentage change in the ACO coefficient between these two models. We considered a change in more than 20 percent in the ACO coefficient (Shadish et al. 2002) once EHR functionality was included, as evidence that more advanced EHR functionality may mediate the positive association of ACO participation and greater CTM processes.

As an additional sensitivity analysis, we estimated the regression models using a dichotomous measure of “basic EHR functionality” instead of the 14-item EHR functionality composite to explore the extent to which basic EHR functionalities versus advanced features were driving the overall association of EHR functionality and CTM processes (Model 3). The electronic health record functions in defining basic functionality included a patient problem list, progress notes, patient medications, laboratory results, and electronic prescribing (Furukawa et al. 2014).

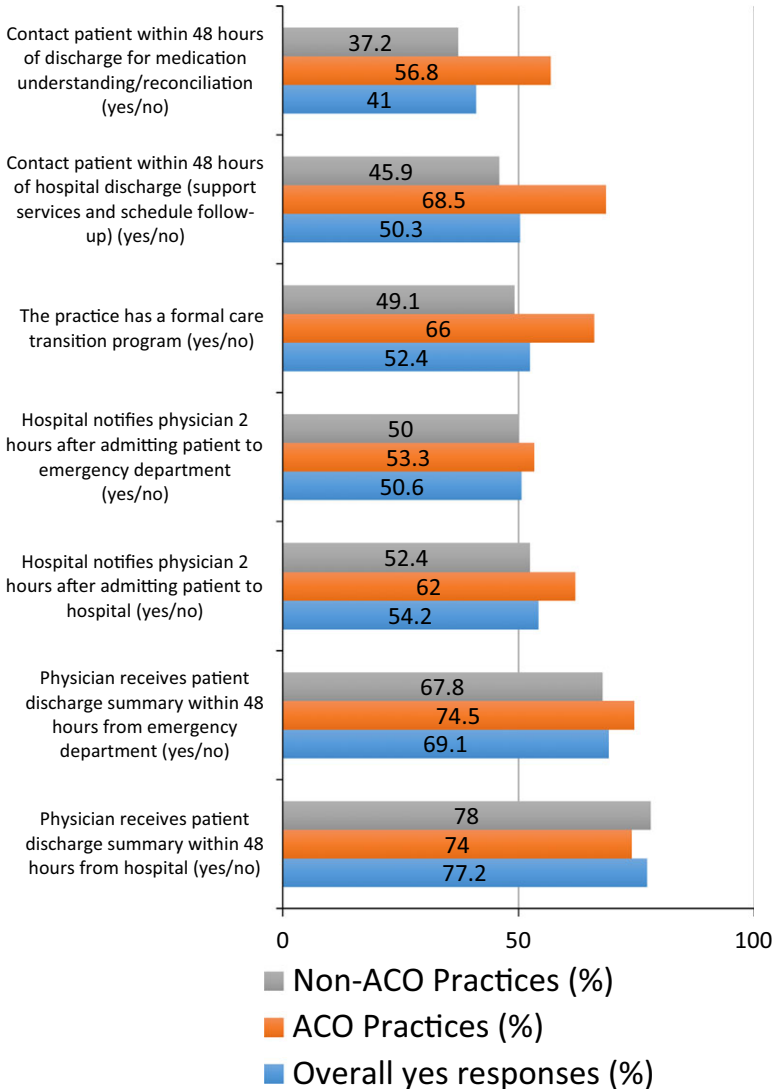
All results were weighted to be nationally representative of physician practices, adjusting for the complex survey design of NSPO3 and selection and nonresponse probabilities (Wiley et al. 2015).

RESULTS

Approximately half (52.4 percent) of practices had a formal program for managing care transitions in place. Physicians receiving patient discharge summaries from the hospital and ED had the highest levels of practice adoption (77 and 69 percent); these were the most commonly adopted CTM processes followed by 2-hour notifications of admission (54 and 51 percent) and contacting patients postdischarge (50 and 41 percent). Practices participating in ACOs were more likely to use each of the individual care transition processes with the exception of physicians receiving discharge summaries from the hospital, where there were no significant differences in the adoption of this CTM process between ACO versus non-ACO practices (Figure 1).

Table 1 highlights the terciles of CTM processes and differences in organizational characteristics between practices with different levels of CTM

Figure 1: The Adoption of Care Transition Management Capabilities, by ACO Participation [Color figure can be viewed at wileyonlinelibrary.com]



Notes: ACO practices and non-ACO comparisons were statistically significant at the $p < .001$ level, with the exception of the question assessing whether physicians receive patient discharge summary within 48 hours, which had a significance level of $p < .05$.

Table 1: Comparison of Practice Characteristics by Extent of Practice Adoption of Care Transition Management Processes (CTM)

<i>Practice Characteristic</i>	<i>All Practices (%) (n = 1,398)</i>	<i>Low CTM Practices (%) (n = 409)</i>	<i>Medium CTM Practices (%) (n = 431)</i>	<i>High CTM Practices (%) (n = 558)</i>
Accountable care organization (ACO) participation (%)	19.3	14.3	14.9	26.5***
Specialty mix				
100% primary care (%)	71.6	71.7	78.1	66.2**
33–99% primary care (%)	17.2	17.5	11.1	22.1**
<33% primary care (%)	11.2	10.8	10.8	11.7**
Practice size				
1–2 physicians (%)	55.5	55.1	52.2	58.5
3–9 physicians (%)	32.9	29.1	39.1	30.6
10–19 physicians (%)	3.5	4.4	1.9	4.3
20+ physicians (%)	8.1	11.5	6.8	6.7
Ownership				
Physician owned (%)	82.7	87.1	77.4	83.9
Hospital or health system owned (%)	13.2	7.5	20.0	11.6
Federally qualified community health center owned (%)	4.1	5.4	2.6	4.5
Pay-for-performance index				
No points (%)	49.0	47.1	61.6	39.9***
1 point (%)	29.4	30.9	26.9	30.4***
2 points (%)	13.1	11.7	5.4	20.5***
3 points (%)	8.5	10.3	6.1	9.1***
Public reporting index				
No points (%)	47.5	50.4	54.5	39.7***
1 point (%)	20.4	18.7	21.3	20.1***
2 points (%)	32.1	30.9	24.2	39.6***

Note. Low CTM practices had 1–2 CTM processees, medium CTM practices had 3–5 CTM processes, and high CTM practices had 6–7 CTM proceses.

* $p < .05$, ** $p < .01$, *** $p < .001$ indicate statistically significant differences in overall group comparisons.

capabilities—“low” (0–2 capabilities) versus “medium” (3–5 capabilities) versus “high” (6–7 capabilities). In bivariate analyses, practices with high CTM capabilities were more likely to be ACO participants (26.5 percent vs. 19.3 percent overall, $p < .001$). Practices with medium CTM capabilities had greater proportions of primary care physicians relative to specialists (78.1 percent vs. 71.65 overall, $p < .001$), while practices with high CTM capabilities were more likely to be mixed specialty practices (22.1 percent vs. 17.2,

$p < .05$) and specialist practices (11.7 percent vs. 11.2 percent, $p < .05$). Practices with medium CTM capabilities had the highest levels of participation in pay-for-performance (61.6 percent vs. 49 percent, $p < .001$) and public reporting (54.5 vs. 47.5 percent, $p < .001$) programs.

In the multivariate linear regression analysis, ACO participation ($\beta = 0.81$, $p < .001$) was significantly associated with greater care transition management capabilities (Table 2, Model 1). The ACO effect size ($\beta = 0.88$, $p < .001$) was similar when the model included EHR functionality (Table 2, model 2). EHR functionality was moderately associated with greater CTM capabilities. Sensitivity analysis using a Poisson regression model resulted in similar findings as the main linear regression model.

As the ACO effect did not attenuate when EHR functionality was considered (Model 1 vs. Model 2), there is no evidence of a mediating role of EHR functionality in explaining the ACO participation–CTM capabilities relationship. These results suggest that ACO participation and EHR functionality have independent influences on the development CTM capabilities.

Our additional sensitivity analysis (Model 3) revealed that a dichotomous measure of basic EHR functionality was associated with less adoption of CTM processes (effect = -0.81 , $p < .001$). These results indicate that practice use of more advanced or expanded electronic health record functions—such as physicians using EHRs for drug interactions, reminders, and abnormal test results; collecting clinical quality data; electronic access for patient emergency department visits; hospital discharge summaries, and pharmacy records; and patient email communication—account for the positive association of EHR functionality and more developed CTM processes.

DISCUSSION

We used a nationally representative sample of medical practices to examine the association of ACO participation, EHR functionality and medical practices' care transition management capabilities and found that practices participating in ACO are more likely to adopt processes central to managing care transitions compared to non-ACO participants, controlling for practice type, size, ownership, public reporting, and pay-for-performance. EHR functionality was positively and independently associated with more CTM processes, consistent with previous research highlighting that EHR can enable the development of CTM capabilities (Robinson et al. 2009; McClellan et al. 2013; Wiley et al. 2015). We did not find support for our hypothesized mediating

Table 2: The Association of ACO Participation, Electronic Health Record Functionality, and Care Transitions Management Processes

Variable	Model 1	Model 2	Model 3
	ACO	ACO+ EHR (14) ⁺	ACO+ EHR(5) ⁺
Accountable care organization (ACO) participation			
Not participating in an ACO (ref)	–	–	–
Participating in an ACO	.814***	.822***	.826***
Electronic health record functionality	–	.043**	–.812***
Specialty mix <33% primary care physicians (ref)	–	–	–
Between 33–100% primary care	1.083***	1.126***	.591*
100% primary care	–.530**	–.495**	–.441*
Practice size			
1–2 physician practice (ref)	–	–	–
3–9 physicians	–.663***	–.741***	–.827***
10–19 physicians	–.960***	–1.091***	–.858*
20+ physicians	–1.69***	–1.838***	–1.185***
Ownership			
Physician owned (ref)	–	–	–
Hospital or system owned	.064	–.233	.749***
Federally qualified health center owned	–.206	–.277	.674
Public reporting index			
Neither patient satisfaction nor quality is publicly reported (ref)	–	–	–
Either quality or patient satisfaction	.034	–.042	.129
Both quality and patient satisfaction	.559***	.521***	.432*
Pay-for-performance index			
No points (ref)	–	–	–
One point	.489***	.547***	–.238
Two points	1.12***	1.086***	.231
Three points	–.099	–.209	–.194

Continued

Table 2. Continued

Variable	Model 1	Model 2	Model 3
	ACO	ACO+ EHR (14)+	ACO+ EHR(5)+
	Adjusted <i>R</i> -squared = .268	Adjusted <i>R</i> -squared = .272	Adjusted <i>R</i> -squared = .204
	Adjusted <i>F</i> value = 16.07***	Adjusted <i>F</i> value = 15.62***	Adjusted <i>F</i> value = 7.52***

Notes. The results also control for state-fixed effects to adjust regression model estimates for state health policies and resources that could impact the development of care transitions management processes.

+EHR(14) is the 14-item full electronic health record functionality, and the EHR(5) is the basic 5-item electronic health record functionality.

p* < .05, *p* < .01, ****p* < .001.

effect of EHR on the relationship between ACO participation and CTM capabilities. Rather, ACO participation and expansion of EHR functionality may have independent positive influences on the development of care transition management capabilities. The results suggest that ACO participation without internal efforts to expand EHR functionality may be limited in expanding the use of structures and processes for improving care transitions.

Our results should be considered within the context of several limitations. First, other delivery system reforms might have fostered the development of CTM capabilities among practices. For example, the role of the American Recovery and Reinvesting Act and the Health Information Technology for Economic and Clinical Health Act has greatly impacted the use of chronic care management processes, including care transitions (Sharma et al. 2016), and the CMS has implemented several reimbursement and payment mechanism changes to hospital readmissions that can cultivate the development and improvement of CTM capabilities, for example, financial penalties for preventable readmissions and identifying clinical reasons for readmission like surgical site infection and obstructions (Leape 2015; Merkow et al. 2015; O'Brien et al. 2015). Our analyses controlled for some aspects of delivery reform like public reporting of outcomes and pay-for-performance, but these variables are not exhaustive and other variables could be considered. Many of these improvement initiatives, however, are implemented at the state level and we use state-fixed effects to control for state-specific policy differences that can impact the development of CTM processes. Second, while identifying the most informed practice leader for addressing factual questions, the responses are based on a single respondent and resources did not permit independent validation. It is also possible that practices that were included in our study

differ from those that chose not to participate. The 50 percent response rate is consistent with other recent surveys of physician organizations, and prior articles have described the slight differences between respondent and nonrespondent practices in the NSPO3 survey (Wiley et al. 2015). Our analyses were weighted to partially account for these differences. Third, it is also possible that our analysis omitted variables important to CTM structures and processes, for example, the use of a care transitions nurse (Coleman et al. 2006), and thus our estimates may over- or underestimate as a result of omitted variable bias. The CTM composite measure does not cover all components of care transitions; for example, employing a transitional care nurse or care coordinator, home visits, medication self-management support, and other multidisciplinary approaches to managing care transitions (Coleman et al. 2004; Naylor 2006). Further studies could explore these components alongside the CTM processes we examined. Finally, no inferences can be drawn regarding causality, as it is certainly possible that practices with greater CTM capabilities or EHR functionality are more likely to join ACOs.

The CTM process measure used in our study does not cover all components of care transitions; for example, employing a transitional care nurse or care coordinator for CTM, home visits, medication self-management support, and other multidisciplinary approaches to managing care transitions (Coleman et al. 2004; Naylor 2006). Further studies could explore these components alongside the care transition management processes we examined. Additional next steps for research in this area could include mixed methods or qualitative studies of the development, improvement, and sustainment of CTM structures and processes through ACO incentives; describing new and innovative care transition capabilities fostered through ACO participation; and utilizing claims data to explore the relation of CTM capabilities, patient-centered outcomes of care, and hospital readmission rates. Since most care transitions studies focus on the process between the hospital and home or physician practice visit, it will be important to consider upstream care transition processes.

The effective management of care transitions is foundational to a well-coordinated health care delivery system, particularly given the growing number of aging Americans with chronic illness who receive care in a wide range of care settings. Improving care coordination and promoting EHR functionality may aid in achieving the triple aim of better care, improved population health, and reduced rate of growth in costs. The current research highlights the positive association of ACO participation and greater EHR functionality with the greater care transition management capabilities among practices.

Our results highlight that practices may need to move beyond adopting basic EHR functions and move toward the use of advanced features that support the management of care transitions. The growth of ACO risk-bearing contracts in both the governmental and commercial sectors is likely to be associated, in part, with the expansion of medical practice capabilities to manage care transitions more effectively.

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SUPPORTING INFORMATION

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

Appendix SA1: Author Matrix.

Appendix SA2. Expanded Electronic Health Record Functions Index (Range: 0–14 points). Adapted from Rodriguez et al. (2015) and Wiley et al. (2015).