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A Taxonomy of Hospitals Participating in Medicare Accountable Care Organizations

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Abstract

Background—Medicare was an early innovator of Accountable Care Organizations (ACOs), establishing the Medicare Shared Savings Program (MSSP) and Pioneer programs in 2012–13. Existing research has documented that ACOs bring together an array of health providers with hospitals serving as important participants.

Purpose—Hospitals vary markedly in their service structure and organizational capabilities, and thus, one would expect hospital ACO participants to vary in these regards. Our research identifies hospital sub-groups that share certain capabilities and competencies. Such research, in conjunction with existing ACO research, provides deeper understanding of the structure and operation of these organizations. Given that Medicare was an initiator of the ACO concept, our findings provide a baseline to track the evolution of ACO hospitals over time.

Methodology/Approach—Hierarchical clustering methods are used in separate analyses of MSSP and Pioneer ACO hospitals. Hospitals participating in ACOs with 2012–13 start dates are identified through multiple sources. Study data come from the Centers for Medicare and Medicaid Services, American Hospital Association, and Health Information and Management Systems Society.

Results—Five-cluster solutions were developed separately for the MSSP and Pioneer hospital samples. Both the MSSP and Pioneer taxonomies had several clusters with high levels of health information technology capabilities. Also distinct clusters with strong physician linkages were present. We examined Pioneer ACO hospitals that subsequently left the program and found that they commonly had low levels of ambulatory care services or health information technology.

Conclusion—Distinct subgroups of hospitals exist in both the MSSP and Pioneer programs, suggesting that individual hospitals serve different roles within an ACO. Health information technology and physician linkages appear to be particularly important features in ACO hospitals.

Practice Implications—ACOs need to consider not only geographic and service mix when selecting hospital participants but also their vertical integration features and management competencies.

Keywords

Accountable Care Organizations; hospitals; organizational taxonomy

Introduction

Rapid development of Accountable Care Organizations (ACOs) is underway as health care providers respond to new opportunities and incentives. The Centers for Medicare and Medicaid Services (CMS) initiated activity in this area as a result of provisions in the 2010 Affordable Care Act, establishing two ACO programs – the Medicare Shared Savings Program (MSSP) and the Pioneer ACO Program. Subsequently, these early CMS initiatives provided the foundation for private sector efforts to develop similar arrangements with health care providers that contain spending, share savings, and maintain quality standards (McClellan et al. 2010; Muhlestein and McClellan 2016). In 2012–13, there were 355 designated MSSP ACOs and 32 Pioneer ACOs, some of which subsequently transitioned to MSSP or dropped out of ACO programs altogether (CMS 2015), Department of Health and Human Services 2015).

Both the initial MSSP and Pioneer ACO models as well as more recent ACO efforts share similar organizational objectives, namely creating networks of health care providers that work together to provide a continuum of care to beneficiaries in defined geographic areas. ACOs link numerous physician organizations (including physician group practices and Independent Practice Associations), hospital organizations (including individual institutions and integrated hospital systems), and other community providers (Shortell et al., 2014; Shortell 2016). CMS developed provider listings that identified 9,192 participating provider organizations for the 355 initial MSSP ACOs (CMS 2013). On-line listings of Pioneer ACOs also suggest substantial numbers and diversity of participants (CMS 2015). Shortell et al. (2014) noted the diversity in organizational structure in ACOs, and he and his colleagues conducted cluster analysis to identify predominant ACO forms. Specifically, they identified three clusters of ACOs focused primarily on their leadership structure and aspects of their service mix: 1) large integrated health systems with a broad array of services; 2) physician group practices focused largely on primary care; and 3) joint physician-hospital initiatives with moderate service levels. While providing valuable insights into these overarching organizational forms, additional research that looks inside ACOs at the structure and capabilities of involved organizations can provide complementary information that will help researchers, health administrators, and policy makers better understand how ACOs operate. In particular, it is worthwhile to examine the service structure and capabilities of ACO hospitals, because as Diana et al. (2015) noted, hospitals can provide key vertical integration components and administrative capacity that ACOs require. Also, hospitals provide

expensive and intensive health services to patients, and thus offer opportunities to ACOs to control costs through better care management. A taxonomy of ACO hospitals would complement the overarching ACO forms identified by Shortell and colleagues and would aid research examining the association of ACO structural characteristics with patient outcomes and costs of care. The primary objective of our study is to develop a taxonomy of ACO hospitals.

Decades of hospital research make clear that hospital organizations are quite diverse in terms of size, service mix, ownership, teaching status, and involvement in diverse types of multi-hospital systems. Diana et al. (2015) suggested that diversity may also exist in the capabilities that hospitals bring to an ACO relationship. In particular, he and his colleagues noted that hospital organizations differ in their strategies to align with physicians in their communities, create and coordinate an array of health services, acquire and integrate health information technology, and manage diverse administrative functions. As ACOs have developed, their leaders likely have looked to hospitals not just as sites of care, but also in some cases as key partners in providing necessary competencies, capabilities, and strategic linkages. Colla et al. (2016) noted that ACOs with hospital participants had twice as many participating physicians than did ACOs lacking hospital involvement. Our taxonomic analysis focuses on the competencies and service integration capabilities that hospitals can provide, since these are important to meeting ACO imperatives of cost control and quality performance. We also distinguish Pioneer and MSSP ACO hospitals in our analysis as the need to manage financial risk varies across these two ACO models.

Also, by studying early initiatives and early participants in ACOs, our research provides insights on first movers in this important area of health care delivery reform. Such understanding can assist those provider organizations still considering ACO development or involvement by providing understanding of the strategies and structures used by early adopters. Public and private policymakers can also obtain a needed baseline about early innovators from which to study the evolution of these arrangements. CMS has recognized the importance of this in its more recent ACO efforts, particularly the Next Generation ACOs, which they describe as an extension that builds on the experiences of their earlier ACO efforts (CMS 2016).

Theory/Conceptual Framework

ACOs represent a type of vertical integration in which an array of providers come together to create a continuum of health care services and to operationally integrate these services to meet the needs of defined populations (Chukmaitov et al. 2015, Diana et al. 2015, Mick and Shay 2016). Thus, the theoretical perspectives of transaction cost economics are particularly salient in thinking about ACO development and also about the role that hospitals can play within ACOs. As noted by Diana et al. (2015), from a transaction costs economics view "... certain hospitals may possess pre-existing capabilities that not only lower the costs of ACO development but also increase the likelihood that these hospitals will generate savings from ACO participation" (page 227). Mick and Shay (2016) note that the service and operational continuum ACOs must organize can be viewed as a chain of transactions or exchanges. Consistent with Diana et al. (2015), then, this implies that hospitals that possess certain

critical features along this vertical chain may be favored for ACO participation over hospitals lacking such characteristics. Diana et al. (2015) also considered the perspectives of strategic management theory, suggesting that hospitals with pre-existing capabilities are better able to manage task dependencies that are inherent within ACOs.

Industry leaders and organizational researchers have identified various capabilities that must be present within ACOs, including: a continuum of primary and specialty care services; coordination and integration of various physician, hospital, and other health care providers; and a seamless flow of clinical and management information (Chukmaitov et al. 2015; Colla et al. 2016; Diana et al. 2015; Devers and Berenson 2009; Shortell and Casalino 2010). Hospitals invited to participate in an ACO, or that lead efforts to form an ACO, can bring some or all of these types of expertise. In particular, Diana et al. (2015) noted that many hospitals are themselves vertically integrated through formal and informal linkages and thus, can provide a continuum of ambulatory care services, which facilitates the delivery of primary and specialized care for ACO covered patients. Chukmaitov et al. (2015) stated that vertical forward integration with physicians and ambulatory care providers in particular can lower transaction costs via efficient negotiating and monitoring of care and can allow for better patient flow across individual services. Diana et al. (2015) and Chukmaitov et al. (2015) both noted the importance of physician alignment and also that hospitals have long histories creating and maintaining physician networks. Chukmaitov and colleagues further commented on the importance of tightly aligned hospital-physician arrangements, in which physicians are employed or their medical practice assets are acquired by hospitals, to improve quality and cost-related performance.

In addition, Diana et al. (2015) stated that bringing together a continuum of primary care and specialty services, although an important attribute that hospitals can offer an ACO, is insufficient in itself for generating benefits from vertical integration. They discuss the essential role that health information technology, especially electronic health records (EHRs), in facilitating care coordination and communication. Hospitals with more advanced EHR capabilities may be especially attractive to ACOs by providing the data systems needed to monitor population health, achieve higher quality care, and contain costs.

Overall, existing theory and literature suggest the importance of three hospital features that would yield benefits through ACO involvement: vertical forward integration into ambulatory services; broad-based linkages with physicians; and electronic health record capabilities. Table 1 describes the specific measures we use to proxy these potential hospital competencies. These measures are based on those developed by Chukmaitov et al. (2015) with some being the result of data reduction approaches to consolidate various variables into a smaller number of dimensions, especially in relation to the range of ambulatory services offered by a hospital and its EHR capabilities. For ambulatory services, this earlier study examined eight different service categories and the five listed in Table 1 formed a single factor. For EHR capabilities, Chukmaitov et al. (2015) examined eight capabilities identified by Furukawa et al. (2010) in their EHR taxonomy, which is based on the Health Information and Management Information Systems Society (HIMSS) EHR Adoption Model (Garets and Davis 2006). Factor analysis of these eight items resulted in one factor with five EHR

capabilities corresponding to Furukawa and colleagues' basic EHR category and a second factor with two EHR functions corresponding to their more advanced EHR category.

Method

Study Sample

Several sources of data were used to identify hospital ACO participants. We limited our attention to CMS ACOs that were in US states and the District of Columbia and that had ACO start dates in 2012 and 2013. Thus, our taxonomy is reflective of hospitals participating at the beginning of the MSSP and Pioneer programs.

The primary source of data for MSSP ACOs was CMS listings of participating organizations (CMS 2013). We searched these lists for terms that would identify hospitals, and in some instances, conducted follow-up through on-line websites or phone calls to clarify if the organization was a hospital (e.g., when the term "medical center" was used). We also used listings generated by the Research Data Assistance Center to identify additional hospitals participating in the MSSP ACO program, and again relied on on-line web searches or phone calls to clarify ambiguities. In those cases where a multi-hospital system was listed as an ACO participant, we contacted system representatives to determine which hospitals were actually involved with the ACO. For Pioneer ACOs, CMS online information provided detailed descriptions of key organizational participants for the 32 originally designated Pioneer ACOs (CMS 2013). On-line searches of these ACOs were undertaken to confirm and identify additional hospital participants, and ACO representatives were contacted by phone to clarify ambiguities.

For the MSSP ACO program, we identified 385 non-federal general medical/surgical hospital participants with 2012 or 2013 start dates, and for the Pioneer ACO program, the count of identified hospitals was 133 among the original 2012 participants. Of these, 325 MSSP hospitals and 101 Pioneer hospitals had complete, non-missing American Hospital Association (AHA) Annual Survey and HIMSS Analytics data for all study variables in Table 1. We were able to compare hospitals with complete information on Table 1 measures to those hospitals lacking complete data on several organizational characteristics that are more commonly reported through the AHA Annual Survey, namely ownership type, bed-size, teaching status, system membership and urban/rural location. In both the MSSP and Pioneer samples, the only significant difference ($p < .05$) across these characteristics was for ownership status with for-profit hospitals more frequently having incomplete data on Table 1 items. Thus, our results are more reflective of non-profit ACO hospitals. For-profit hospitals, however, are a small percent of early adopting ACO hospitals, representing roughly 5% of MSSP hospitals and 11% of Pioneer hospitals in 2012–13 whereas national statistics for for-profit community hospital ownership was roughly 21% in these years (author analysis of AHA Annual Survey data). Of the original Pioneer hospital sample, 27 dropped involvement in this program as of 2014. Our taxonomic analysis will examine all original 101 Pioneer hospitals, but we also conduct a sensitivity analysis excluding these 27 hospitals.

Study Data and Measures

For the physician linkages measures in Table 1, we used AHA data on the number of physicians affiliated with various physician organizational arrangements, using the loose/tight classification scheme developed by Dynan et al. (1998). To standardize these measures across hospitals of different size, these counts were divided by the number of inpatient days provided at the hospital (measured in 1000s). Hospital involvement in ambulatory services was measured by the count of the five services noted in Table 1. Finally, counts of basic and advanced health information technology (IT) were derived from HIMSS data. We used AHA and HIMSS data from the specific year in which an ACO started in the CMS program to create these measures (e.g., 2012 data for hospitals in ACOs that began that year, and 2013 data for hospitals in ACOs starting in 2013). This approach recognizes that participating hospitals either had in place, or enhanced, their capabilities to best serve the ACO as it began operation.

Analytical Steps to Taxonomy Development

The steps involved with taxonomy development have been applied in several other studies (Bazzoli et al. 1999; Lee et al., 2008; Lewis and Alexander, 1986; Shortell et al., 2014; Weiner and Alexander 1993). Table 1 measures are used in the clustering analysis, which ultimately derives sub-groups of hospitals that share similar values on one or more of these characteristics. Each of the Table 1 measures is transformed into z-scores to ensure that different scaling and dispersion does not influence cluster solutions.

Because cluster solutions can be affected by observations with atypical values in clustering variables, analysis of potential outliers is an essential starting point (Ketchen and Shook 1996). We used principal components analysis to create composite scores across measures in Table 1, and then examined those principal components with eigenvalues greater than 1. The mean plus or minus three standard deviations was used to identify potential outliers for these principal components. We eliminated two Pioneer ACO hospitals and seven MSSP hospitals through this process. Atypically high values for the physician linkage variables were the primary reason driving unusual principal component scores.

The major steps to cluster analysis were then undertaken first for Pioneer hospitals and then for MSSP hospitals:

- **STEP 1: *Split-half cluster analysis.*** Observations are split randomly into two halves and the hierarchical Ward partitioning method is applied. Split-half analysis is done for two reasons. First, this allows us to assess how many unique clusters were present in the data based on statistics generated by cluster analysis, namely the Cubic Clustering Criterion (CCC), Pseudo F statistic, and Pseudo t-squared statistic. Milligan and Cooper (1985) and SAS Institute (2010) recommend that all three of these statistics be interpreted jointly to derive the optimal number of clusters in a data set. Second, by comparing findings across the two split halves, we could assess if the cluster solutions are similar in terms of key distinguishing features, and thus, the cluster solutions are reliable. Duncan multiple range tests are used to identify distinguishing features of each cluster.

- **STEP 2: *Combined sample cluster analysis*:** The split halves are then joined and the hierarchical Ward's method is applied using the optimal number of clusters identified through the split-half analyses. Duncan multiple range tests are again used to assess distinguishing characteristics of resulting clusters. The results from the combined sample cluster solution are compared to the split-half results, not only in terms of distinguishing characteristics but also counts of hospitals by cluster, to assess cluster solution reliability.
- **STEP 3: *Discriminant analysis*:** This step is undertaken to generate discriminant functions that allow one to classify organizations into the identified clusters. The discriminant analysis also allows internal validation of the cluster solution through assessment of the rate of correct classification in which the cluster assignment of a hospital from Step 2 is compared to the predicted cluster assignment derived from the discriminant functions.

We also examined differences in typical characteristics used to distinguish hospitals (e.g., ownership, teaching status, geographic location, bed size) to assess if these features differed across the hospital clusters. Finally, we conducted cluster analysis excluding hospitals that dropped out of the Pioneer program and also examined whether drop-outs were concentrated in particular ACO hospital clusters.

Results

Taxonomy Analysis of Pioneer ACO Hospitals

Split-half analysis for the Pioneer ACO hospitals supported a five-cluster solution given statistics generated through the cluster analysis and also the pattern of dominant variables across the split-half clusters. Statistics generated for the combined sample cluster analysis also suggested five clusters were optimal, although some of these statistics suggested potentially four clusters (see notes to Table 2). In particular, the CCC exceeded the threshold value of 2 and leveled off in value at 4 to 5 clusters, the pattern of the Pseudo F statistic supported 5 clusters whereas the pattern of the Pseudo t-squared statistic supported 4 clusters. Given the support of five clusters in the split-half analysis and the consistent patterns of dominant variables in the split-half and combined analysis, a five cluster solution was chosen as optimal. Discriminant analysis for the five-cluster solution yielded a 99.5% rate of correct classification, which indicates that the five-cluster solution was internally valid.

Table 2 reports data and statistical tests on each of the clustering variables across the five clusters. The values reported represent average values of the variables rather than z-scores to aid interpretation. In each case, an ANOVA test indicated that the clustering variable was significantly different across clusters ($p < .01$). Cluster labels are reported in the top row of the table based on the patterns of significantly different variables. Four of the five clusters (Clusters 1, 2, 4, and 5) all had high values of the health IT variables, with each cluster having an average value close to the maximum of five basic EHR functions and two advanced functions. Cluster 3 (13 hospitals, 13%), on the other hand, was distinguished by low health IT. Cluster 1 (30 hospitals, 30%) was also distinguished by high values of

ambulatory care services compared to the other clusters, whereas Cluster 2 (40 hospitals, 41%) had low values of ambulatory services. Cluster 4 (7 hospitals, 7%) like Cluster 1 had high values of ambulatory care services but this was coupled with high values of tightly aligned physicians. Finally, Cluster 5 (9 hospitals, 9%) stood out in terms of high values of loosely aligned physicians. Cluster 1 also had relatively high values of this variable when compared to Clusters 2, 3, and 4, but Duncan multiple range tests indicated that differences between these clusters were not statistically significant.

Taxonomy Analysis of MSSP ACO Hospitals

Split-half analysis for the MSSP ACO hospitals provided strong support for a five-cluster solution, and statistics from the combined sample cluster analysis also concurred with this conclusion, as illustrated by the cluster statistics in the notes to Table 3. Discriminant analysis for the five-cluster solution generated a 92% rate of correct classification, suggesting that the five-cluster solution was internally valid.

Table 3 reports the average values and statistical tests for the clustering variables in the MSSP hospital analysis. Similar to the Pioneer clusters, ANOVA analysis for each of the clustering variables indicated significant differences in value across the five clusters ($p < .01$). Also, consistent with the Pioneer results, we find that health IT had high averages near the maximum values for these variables in four of the five MSSP clusters, with the exception being Cluster 3 (50 hospitals, 16%). Cluster 1, which had 62 hospitals (19%), was also distinguished by having a low level of ambulatory care services. Cluster 2 (146 hospitals, 46%) had somewhat higher average values of ambulatory services than did the other clusters, but Duncan multiple range tests indicated that this value was not significantly different from those observed for Clusters 3 to 5. Additionally, Cluster 4 (26 hospitals, 8%) and Cluster 5 (34 hospitals, 11%) were distinguished by having high levels of tight physician alignment and high levels of loose physician alignment, respectively.

Examination of Hospital Characteristics by Pioneer/MSSP Cluster

Tables 4 and 5 provide additional information on the ACO hospital clusters, specifically reporting other organizational characteristics that were not used in the cluster analysis. Table 4 focuses on Pioneer hospital clusters. Hospital bed size was not significantly different across Pioneer clusters nor was ownership or teaching status. Because over 90% of Pioneer hospitals were not-for-profit, we combined other ownership types (i.e., for-profit and public ownership) in one category. For Pioneer clusters, multi-hospital system membership and urban location were significantly different across the clusters. Relatively few hospitals in the high ambulatory services, tight physician alignment, & health IT cluster and few in the high loose physician alignment & health IT cluster belonged to multi-hospital systems when compared to hospitals in other clusters. Additionally, hospitals in the former cluster and those in the low health IT cluster were more often located in rural areas.

Table 5 reports similar information for the MSSP hospitals. For those in the low ambulatory care services but high health IT cluster, hospitals had smaller bed size and were less often teaching hospitals. Hospitals in the low health IT cluster were less often not-for-profit relative to hospitals in other clusters, with these other clusters generally having 85% to 94%

of their hospitals as not-for-profit. Similar to the Pioneer clusters, MSSP hospitals in the high tight physician alignment & health IT group were less often members of multi-hospital systems and more often located in rural areas.

Sensitivity Analysis

Given the large number of hospitals that had exited the Pioneer program as of 2014, a separate cluster analysis was conducted on the 72 hospitals that remained with Pioneer to assess if the cluster solution would change. This analysis indicated that a five-cluster solution was present based on split-half and combined sample analysis. Duncan multiple range tests of the five-cluster solution identified the same distinguishing characteristics as those identified in Table 2 for the sub-sample of hospitals continuing their Pioneer involvement. Thus, the cluster analysis results were robust when the exiting Pioneer hospitals were excluded.

Cluster Assignments of Exiting Pioneer Hospitals

For the 27 hospitals exiting Pioneer, we examined their cluster assignments in the original analysis reported in Table 2. Overall, 16 exiting Pioneer hospitals were in the low ambulatory services but high health IT cluster, which translates into 40% of the hospitals in this cluster as reported in Table 2, and 6 were in the low health IT cluster, which is 46% of hospitals in this cluster. Exit rates for the other Pioneer clusters ranged from 0% to 14%. The six hospitals that exited from the low health IT Pioneer cluster did not transition to the MSSP program but stopped ACO involvement altogether, whereas those hospitals that exited from the low ambulatory care services but high health IT Pioneer cluster were evenly split between transitioning to MSSP and ending ACO involvement.

Discussion

Hospitals not only provide sites of essential services for ACOs but also can have many vertically integrated features and administrative competencies necessary for ACO operation. ACOs involve a variety of health care providers, including physicians and hospitals, which together offer the array of ambulatory and inpatient care that patients need. Also hospital participants in ACOs can either have in place or develop the competencies essential to coordinate and integrate a continuum of care, oversee provider activities, and manage financial risk. Our taxonomy of hospitals participating in initial CMS ACOs focused on certain organizational competencies that industry experts have suggested are important to ACO success and for which hospitals have gained capacity and expertise over the years (Chukmaitov et al. 2015; Colla et al. 2016; Diana et al. 2015; Devers and Berenson 2009; Shortell and Casalino 2010). We examined specific features discussed by Diana et al. (2015) in their theoretical discussion of transaction costs economics and strategic management theory and how these apply to vertically integrated hospitals that might participate in ACOs. Namely, we examined hospital provision of ambulatory care services, alignment with physicians, and implementation of key health IT functions.

One key observation from our analysis of hospital participants of early CMS ACO initiatives is the importance of health IT capabilities among hospital participants. Most of the Pioneer

and MSSP clusters had substantial development of the basic and advanced EHR capabilities highlighted in the HIMSS EHR Adoption model (Furukawa et al. 2010, Garets and Davis 2006). This finding is consistent with theoretical arguments of Diana et al. (2015) that vertical integration of ambulatory care and physician services within hospitals in and of itself was insufficient to ensure beneficial outcomes from ACO participation because a strong health IT infrastructure needed to be present to facilitate care coordination and communication.

A second common trait that distinguished specific subgroups of ACO hospitals, whether they were clusters for MSSP or Pioneer, was the extent of their physician alignment. Both the MSSP and Pioneer hospital taxonomies had clusters in which physician engagement, either through tight arrangements (e.g., physician employment or practice ownership) or loose arrangements (such as Physician Hospital Organizations and hospital-sponsored Independent Practice Associations), was high. This finding is also consistent with theoretical observations of Diana et al. (2015), which suggested that vertical alignment between hospitals and their affiliated physicians might reduce transaction costs for ACOs and allow these organizations to take advantage of economies of scope. In particular, ACOs may be looking to certain subgroups of hospitals to provide needed physician capacity to deliver a coordinated array of medical services. Our findings in this regard are also consistent with Colla et al. (2016), who contrasted ACOs with and without hospital involvement. They found that ACOs with hospital involvement had substantially more primary care and specialist physician participation than ACOs lacking hospitals. Additionally, ACO leaders interviewed by Colla and colleagues commented that an advantage to hospital participation was better alignment across medical practice and hospital settings to achieve ACO objectives.

This finding is also interesting given the taxonomy of ACO forms developed by Shortell et al. (2014). As noted earlier, they identified three ACO types, one of which was physician group-led ACOs with a focus on primary care services. It may be that such ACOs seek to align with hospitals with a broad physician network, especially if this network includes specialty physician services needed by ACO beneficiaries. An interesting area for future research would be to assess which types of ACO hospitals, as we identified them, align with the ACO types identified by Shortell and colleagues. This would provide greater insights about ACO structure and operation than our taxonomy, or that of Shortell and colleagues, provides on its own.

In contrast to above, though, our analysis indicated that there are subgroups for both Pioneer and MSSP hospitals that had relatively low values on certain competency variables, most notably relatively low values of ambulatory care services in one cluster and low health IT in another. It may be that ACOs seeking out the participation of hospitals in these clusters already have these competencies through other hospitals or through a centralized ACO governance and administrative infrastructure. We conducted subsidiary analysis to explore this possibility by examining a subgroup of MSSP ACOs present in our data that had only one hospital participant. In particular, although the mean number of hospitals in MSSP ACOs in our data was 4.3, one-third of MSSP ACOs had just one hospital. Among hospitals involved with ACOs that had only one hospital participant, we found that 58% were in

Cluster 2 (high health IT) and another 31% were in the two clusters with high physician alignment & health IT. This left just 11% in the two MSSP hospital clusters distinguished by low values of ambulatory services or low values of health information technology, which contrasts to the combined 35% of all MSSP hospitals in these two clusters as reported in Table 3. This suggests that if ACO leaders decide to align with only one hospital, they focus more heavily on hospital capabilities and linkages than would be the case when multiple hospitals are involved. It also implies that ACOs with more than one hospital participant chose hospitals that have complementary capabilities and that some hospitals may play a more supportive service or geographic coverage role.

Similar analysis could not be conducted for the Pioneer ACOs given small numbers, but it is noteworthy that among original Pioneer ACO hospitals that subsequently dropped out of the program, most were concentrated in the clusters with low health IT or low ambulatory care. This suggests that for the Pioneer program, in particular, which involved providers taking on higher levels of financial risk, hospital capabilities in these areas may be especially important for the ACO to provide a coordinated range of health services and to manage payment incentives specific to this program.

Our study has important limitations. First, we used self-reported hospital data that were collected for purposes other than assessing the capabilities and traits that ACO leaders may value in their participating hospitals. We did focus on competencies that Diana et al. (2015) discussed in their theoretical discussion of hospital ACO participation and also those that industry leaders suggested are important for ACOs. It would be worthwhile, however, to conduct qualitative studies of existing ACOs to better understand what they view as important when making decisions about hospital participants. Colla et al. (2016) provided some initial interesting qualitative findings in this regard, but results from their study and ours suggest the need for more depth. Additionally, we examined a limited number of health IT capabilities and given our findings about the importance of health IT, it would be worthwhile to expand upon the set of EHR functions examined. However, doing so would require further conceptual development that expands on the initial work of Furukawa et al. (2010) so that there is some structure to categorizing and classifying the vast array of health IT functions captured in HIMSS surveys.

Finally, we acknowledge that we are examining a group of early implementers and participants in CMS ACOs. The CMS programs have grown and evolved over time and also private ACOs have begun to develop following CMS innovation in this area. However, much can be learned from early adopters as they develop and test out strategies. Indeed, late adopters of innovation typically look to first movers to identify practices and approaches to follow. Further, newer CMS programs are built on the experiences of the past, especially in terms of changing payment and risk models that are being used (CMS 2016, Evans 2014). Even as ACOs develop new financial arrangements and risk models, more than likely the service structure and competencies needed by ACOs to succeed will involve vertical linkages across a multitude of health providers. Thus, hospitals with vertical integration features and health IT capabilities will see advantage in, and be sought out as, important ACO participants. To the extent that ACO delivery structures do change over time, though, our hospital taxonomy and the one developed by Shortell et al. (2014) on overarching ACO

structure will provide important baselines for tracking evolving multi-provider delivery forms.

Practice Implications

Despite these limitations, our study has important implications for the future transformation of the health care delivery system into ACOs or related entities. Leaders of multi-provider arrangements, such as ACOs, need to think carefully about the types of capabilities and competencies that certain affiliated organizations bring to the table. Issues of geographic coverage and service capacity are important but so is the selection of affiliated providers that can bring an array of important organizational linkages, experiences, and competencies that can lead to organizational sustainability and success. Multi-provider arrangements like MSSP ACOs may not require many of their affiliating hospitals to be very distinguished on these capabilities given the incentives and market challenges they face. However, provider organizations will most likely need to take on and manage increasing financial risk, which is true for CMS's Next Generation ACOs and likely so for commercial insurer contracts with private ACOs. In this case, health organizations forming or joining ACOs will face greater needs to coordinate, integrate, and streamline care, and thus, may need to be more attuned to the organizational competencies of their affiliated hospitals and other participating provider organizations.

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References

- Bazzoli GJ, Shortell SM, Dubbs N, Chan C, Kralovec P. A Taxonomy of Healthcare Networks and Systems: Bringing Order Out of Chaos. *Health Services Research*. 1999 Feb;33:1683–1717. [PubMed: 10029504]
- Dynan L, Bazzoli GJ, Burns LR. Assessing the Extent of Integration Achieved through Physician-Hospital Arrangements. *Journal of Health Care Management*. 1998 May-Jun;43:242–262.
- Centers for Medicare and Medicaid Services. [Accessed on [August 25, 2015]] Medicare Shared Savings Program. Accountable Care Organizations Participant Taxpayer Identification Numbers Names. 2013. Available at: <https://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/sharedsavingsprogram/Downloads/ACO-Participant-TIN-Names.pdf>
- Centers for Medicare and Medicaid Services. [Accessed on [June 15, 2016]] Pioneer ACO Model. 2015. Available at: <https://innovation.cms.gov/initiatives/Pioneer-ACO-Model/index.html>
- Centers for Medicare and Medicaid Services. [Accessed on [November 29, 2016]] Next Generation ACOs. 2016. Available at <https://innovation.cms.gov/initiatives/Next-Generation-ACO-Model/>
- Chukmaitov AS, Harless DW, Bazzoli GJ, Carretta HJ, Siangphoe U. Delivery System Characteristics and their Association with Quality and Costs of Care: Implications for Accountable Care Organizations. *Health Care Management Review*. 2015 Apr-Jun;40:92–103. [PubMed: 24566250]
- Colla CH, Lewis VA, Tierney E, Muhlestein DB. Hospitals Participating in ACOs Tend to Be Large and Urban, Allowing Access to Capital and Data. *Health Affairs*. 2016 Mar;35:431–439. [PubMed: 26953297]
- Department of Health and Human Services. [Accessed on [June 15, 2016]] Medicare Program, Medicare Savings Program: Accountable Care Organizations. 2015. Available at: <https://www.gpo.gov/fdsys/pkg/FR-2015-06-09/pdf/2015-14005.pdf>

- Devers, KJ, Berenson, RA. Issue Brief. Urban Institute; 2009. Can Accountable Care Organizations Improve the Value of Health Care by Solving the Cost and Quality Quandaries?. Available at: <http://www.rwjf.org/en/library/research/2009/10/can-accountable-care-organizations-improve-the-value-of-health-c.html> [Accessed on [June 15, 2016]]
- Diana ML, Walker DM, Mora AM, Zhang Y. Vertical Integration Strategies in Healthcare Organizations. *Journal of Health Administration Education*. 2015 Spring;32:223–244.
- Evans, M. [Accessed on [December 1, 2016]] Medicare's Pioneer Program Down to 19 ACOs After Three More Exit. *Modern Healthcare*. 2014. Sep 25, (2014). Available at: <http://www.modernhealthcare.com/article/20140925/NEWS/309259938?template=print>
- Furukawa MF, Raghu TS, Shao BB. Electronic Medical Records, Nurse Staffing, and Nurse-Sensitive Patient Outcomes: Evidence from California Hospitals, 1998–2007. *Health Services Research*. 2010 Aug;45:941–962. [PubMed: 20403065]
- Garets, D, Davis, M. Electronic Medical Records vs. Electronic Health Records: Yes, There Is a Difference. Chicago, IL: HIMSS Analytics; 2006. Accessed at <http://www.himss.org/electronic-medical-records-vs-electronic-health-records-yes-there-difference-himss-analytics> on November 28, 2016
- Ketchen DJ, Shook CL. The Application of Cluster Analysis in Strategic Management Research: An Analysis and Critique. *Strategic Management Journal*. 1996; 17(3):441–458.
- Lee SYD, Alexander JA, Wang V, Margolin FS, Combes JR. An Empirical Taxonomy of Hospital Governing Board Roles. *Health Services Research*. 2008; 43(4):1223–1243. [PubMed: 18355260]
- Lewis BL, Alexander J. A Taxonomic Analysis of Multihospital Systems. *Health Services Research*. 1986 Apr;21:29–56. [PubMed: 3710802]
- McClellan M, McKethan AN, Lewis JL, Roski J, Fisher ES. A National Strategy to Put Accountable Care into Practice. *Health Affairs*. 2010 May;29:982–990. [PubMed: 20439895]
- Mick SSF, Shay PD. Accountable Care Organizations and Transaction Cost Economics. *Medical Care Research and Review*. 2016 Dec;73:649–659. [PubMed: 27009645]
- Milligan GW, Cooper MC. An Examination of Procedures for Determining the Number of Clusters in a Data Set. *Psychometrika*. 1985; 50:159–179.
- Muhlestein D, McClellan M. Accountable Care Organizations in 2016: Private And Public-Sector Growth and Dispersion. *Health Affairs Blog*. 2016
- SAS Institute Inc. SAS/STAT® 9.2 User's Guide: Introduction to Clustering Procedures. Cary: NCL SAS Institute Inc; 2010. Available at https://support.sas.com/documentation/cdl/en/statug/63033/HTML/default/viewer.htm#introclus_toc.htm [Accessed on [November 29, 2016]]
- Shortell SM, Casalino LP. Implementing Qualifications Criteria and Technical Assistance for Accountable Care Organizations. *Journal of the American Medical Association*. 2010; 303(17): 1747–1748. [PubMed: 20442391]
- Shortell SM, Wu FM, Colla CH, Lewis VA, Fisher ES. A Taxonomy of Accountable Care Organizations for Policy and Practice. *Health Services Research*. 2014; 49:1883–1899. [PubMed: 25251146]
- Shortell SM. Applying Organization Theory to Understanding the Adoption and Implementation of Accountable Care Organizations: Commentary. *Medical Care Research and Review*. 2016
- Weiner BJ, Alexander JA. Corporate and Philanthropic Models of Hospital Governance: A Taxonomic Evaluation. *Health Services Research*. 1993 Aug;28:325–355. [PubMed: 8344823]

Table 1
Data and Measures of ACO Competencies Derived from AHA Annual Survey and HIMSS Analytics Data

ACO Competencies	Description	Source and Definition of ACO Measure
Linkages with physicians	Arrangements with primary care physicians and specialists through a variety of physician organization arrangements.	AHA Annual Survey: Number of physicians in physician-organization arrangements (POAs) per 1,000 inpatient days, measured separately for (1) tightly integrated POAs (integrated salary, equity, foundation models, management service organizations), and (2) loosely integrated POAs (group practices without walls, independent practice associations, open physicians-hospital organizations, closed physicians-hospital organizations).
Linkages with ambulatory facilities on a continuum of care	Linkages with services provided through hospital and outpatient providers to coordinate care across the continuum and facilitate comprehensive care across the population in a geographic area.	AHA Annual Survey: Count of five ambulatory care services offered by a hospital: (1) freestanding outpatient center, (2) hospital-based outpatient care center, (3) primary care department, (4) home care, and (5) urgent care.
HIT infrastructure	HIT capabilities that allow the practice of evidence-based medicine, patient engagement, care coordination, and reporting of quality and cost measures.	HIMSS Analytics: Count of five basic HIT applications for (1) pharmacy, (2) laboratory, (3) radiology information systems, (4) clinical data repository, and (5) clinical decision support. Count of two advanced HIT applications for (1) nursing documentation and (2) electronic medication administration.

Notes: AHA is American Hospital Association; HIMSS is the Health Information and Management System Society

Table 2**Pioneer ACO Hospital Clusters**

Cluster Label	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Pioneer - Overall
Count of physicians in loose hospital arrangements per 1000 patient days ***	2.18	0.71	0.31	0	12.69	2.14
Count of physicians in tight hospital arrangements per 1000 days ***	1.38	0.26	0.74	6.79	0.37	1.14
Count of 5 ambulatory services ***	3.57	1.25	2.00	3.29	2.11	2.27
Count of 5 basic Health IT applications ***	4.73	4.78	2.15	4.71	4.78	4.41
Count of 2 advanced Health IT applications ***	1.93	1.85	0.08	1.71	2.00	1.65
Number of hospitals in cluster	30	40	13	7	9	99
Percent of hospitals in cluster	30%	41%	13%	7%	9%	

NOTES:

Summary statistics from combined sample cluster analysis: a) number of clusters at which Cubic Clustering Criterion (CCC) statistic first exceeded value of 2: 4 clusters; b) number of clusters at which CCC value levels off: 5 clusters (CCC at 4 clusters: 4.62; at 5 clusters: 8.82; at 6 clusters: 9.57; c) number of clusters at which Pseudo F statistic levels off: 5 clusters (value equals 51.1 at 4 clusters; 57.2 at 5 clusters; and 56.2 at 6 clusters); d) number of clusters after Pseudo t-squared statistic reaches first peak and then declines: 4 clusters; (value equals 52.0 at 3 clusters; 25.6 at 4 clusters; 24.8 at 5 clusters).

*** characteristic significantly different a $p < .01$ level across clusters.

BOLD values indicate significant different values at $p < .05$ for particular cluster relative to other clusters.

ANOVA analysis used to test for overall significant differences across entire set of clusters; Duncan multiple range tests used to examine significant differences in means across individual clusters.

Table 3**MSSP Hospital Clusters**

Cluster Label	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	MSSP- overall
Count of physicians in loose hospital arrangements per 1000 patient days ***	0.23	0.61	1.22	1.47	9.12	1.61
Count of physicians in tight hospital arrangements per 1000 days ***	0.15	0.46	0.72	5.84	0.57	0.89
Count of 5 ambulatory services ***	0.82	3.09	2.36	2.85	2.71	2.47
Count of 5 basic Health IT applications ***	4.92	4.79	2.32	4.92	4.85	4.44
Count of 2 advanced Health IT applications ***	1.97	1.97	0.56	1.88	1.91	1.74
Number of hospitals in cluster	62	146	50	26	34	318
Percent of hospitals in cluster	19%	46%	16%	8%	11%	100%

NOTES:

Summary statistics from combined sample cluster analysis: a) number of clusters at which Cubic Clustering Criterion (CCC) statistic first exceeded value of 2: 5 clusters; b) number of clusters at which CCC value levels off: 5 clusters (CCC at 4 clusters: 1.95; at 5 clusters: 4.01; at 6 clusters: 4.84; c) number of clusters at which Pseudo F statistic levels off: 5 clusters (value equals 105 at 4 clusters; 106 at 5 clusters; and 101 at 6 clusters); d) number of clusters after Pseudo t-squared statistic reaches first peak and then declines: 5 clusters (value equals 158 at 4 clusters; 18.3 at 5 clusters).

*** characteristic significantly different a $p < .01$ level across clusters.

BOLD values indicate significant different values at $p < .05$ for particular cluster relative to other clusters.

ANOVA analysis used to test for overall significant differences across entire set of clusters; Duncan multiple range tests used to examine significant differences in means across individual clusters.

Table 4

Other Hospital Characteristics of Pioneer Hospital Clusters

	Pioneer - high ambulatory services & health IT	Pioneer - low ambulatory services but high health IT	Pioneer - low health IT	Pioneer - high ambulatory services, tight MD alignment, & health IT	Pioneer - high loose MD alignment & health IT	Pioneer - Overall
Number of staffed and set-up hospital beds	315	230	267	420	234	274
Ownership Type						
Not-for-profit	90.0%	95.0%	100%	85.7%	77.8%	91.9%
Other ownership	10.0%	5.0%	0	14.3%	22.2%	8.1%
Teaching Hospital						
Yes (COTH member or residency programs)	43.3%	22.5%	30.8%	57.1%	44.4%	34.4%
No	56.7%	77.5%	69.2%	42.9%	55.6%	65.7%
Multi-Hospital System Member***						
Yes	63.3%	92.3%	100%	42.9%	55.6%	77.6%
No	36.7%	7.7%	0	57.1%	44.4%	22.5%
Geographic Location**						
Urban area	93.3%	97.5%	76.9%	71.4%	100%	91.9%
Rural area	6.7%	2.5%	23.1%	28.6%	0	8.1%
Number of hospitals	30	40	13	7	9	99

* characteristic significantly different at $p < .10$ level across clusters.

** characteristic significantly different at $p < .05$ level across clusters.

*** characteristic significantly different at $p < .01$ level across clusters.

Note: to test for significant differences across clusters, chi-square tests were used for categorical variables and ANOVA used for continuous variables.

Table 5

Other Hospital Characteristics of MSSP Hospital Clusters

	MSSP - low ambulatory services but high health IT	MSSP - high health IT	MSSP - low health IT	MSSP - high tight MD alignment & health IT	MSSP - high loose MD alignment & health IT	MSSP - Overall
Number of staffed and set-up hospital beds ^{***}	119	284	208	243	338	242
Ownership Type ^{***}						
Not-for-profit	90.3%	91.8%	70.0%	84.6%	94.1%	87.7%
Other ownership	9.7%	8.2%	30.0%	15.4%	5.9%	12.3%
Teaching Hospital ^{***}						
Yes (COTH member or residency programs)	8.1%	42.5%	44.0%	34.6%	38.2%	34.9%
No	91.9%	57.5%	56.0%	65.4%	61.8%	65.1%
Multi-hospital System Member ^{**}						
Yes	85.2%	81.5%	93.9%	69.2%	69.7%	81.9%
No	14.8%	18.5%	6.1%	30.8%	30.3%	18.1%
Geographic Location ^{***}						
Urban area	75.8%	92.5%	84.0%	73.1%	97.1%	86.8%
Rural area	24.2%	7.5%	16.0%	26.9%	2.9%	13.2%
Number of hospitals	62	146	50	26	34	318

* characteristic significantly different at $p < .10$ level across clusters.** characteristic significantly different at $p < .05$ level across clusters.*** characteristic significantly different at $p < .01$ level across clusters.

Note: to test for significant differences across clusters, chi-square tests were used for categorical variables and ANOVA used for continuous variables.