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Organizational Influences on Health Care System Adoption and Use of Advanced Health Information Technology Capabilities

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Abstract

Introduction—The adoption of advanced health information technology (HIT) capabilities, such as predictive analytic functions and patient access to records, remains variable among healthcare systems across the US. This study is the first to identify characteristics that may drive this variability among health systems.

Methods—Responses from the 2017/18 National Survey of Healthcare Organizations and Systems (NSHOS) were used to assess the extent to which health care system organizational structure, electronic health record (EHR) standardization, and resource allocation practices were associated with use of five advanced HIT capabilities. Of 732 systems surveyed, 446 responded (60.9%), 425 met sample inclusion criteria and 389 reported consistent EHR use. Multivariate linear regression with control variables estimated the relationships.

Results—Adoption of advanced HIT capabilities is low and variable, with a mean of 2.4 capabilities adopted and only 8.4% of systems reporting widespread adoption of all five capabilities. In adjusted analyses, EHR standardization (β= 0.76, p =0.001) was the strongest predictor of the number of advanced capabilities adopted, and ownership and management of medical groups (β= 0.32, p =0.04) was also a significant predictor.

Discussion—EHR standardization across organizations within a health care system appears to drive adoption of advanced HIT features.

Conclusion—Health systems that standardize their EHRs and that own and manage hospitals and medical groups have higher rates of advanced health information technology capabilities features. System leaders looking to increase the use of advanced HIT capabilities should consider ways to better standardize their EHRs across organizations.

Precis:

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This is the first national study to examine the relationship between health care system organizational characteristics and adoption of advanced health information technology (HIT) capabilities.

INTRODUCTION

Since the passage of the Patient Protection and Affordable Care Act in 2010, health systems, hospitals, and medical groups have faced considerable public pressure[1] to assume an increased amount of risk for the costs and outcomes of their patient population through value-based payment models. This increased risk requires transforming the way that healthcare services are delivered and reimagining the role that health systems play in managing their patient populations. One response has been the development of over 1,000 accountable care organizations (ACOs) nationwide in 50 states, providing care to nearly 33 million Americans[2]. A key capability of such organizations is their use of advanced health information technology (HIT)[3] but adoption of HIT capabilities necessary to enable value-based care remains slow[4]. While vendors have developed a wider variety of additional capabilities to facilitate patient engagement and performance measurement, wide variability in the uptake of these features by healthcare organizations has caused increasing concerns about a "digital advanced use divide"[5].

Given the extensive and well documented challenges that come with driving innovations in health systems[6], it seems likely that at least some of this variation can be explained by organizational characteristics. Previous studies in medical groups, for example, have found hospital ownership to be predictive of basic HIT adoption and care management processes in medical groups[7,8], and others have found that larger, more integrated ACOs are better positioned for technology adoption[9]. These findings generate further questions regarding the heterogeneity of HIT implementation among health systems, such how they allocate resources for HIT development and the extent to which they standardize their use of HIT.

There is considerable heterogeneity among organizational models used by health systems. In this study, health systems were defined as corporate parents or owner subsidiaries that include either one hospital and at least one set of primary care physicians, two or more hospitals, or two or more primary care groups and are connected by contract or ownership--may own and manage hospitals and medical practices associated with the system or may operate under affiliate models. It is possible that health systems with more direct management responsibilities of their hospitals and medical groups may more effectively integrate different stakeholders--a critical element of innovations in healthcare organizations[10]--and may be able to deliver more training across the enterprise, another critical success factor of EHR implementations identified in previous research[11].

Second, resource allocation practices can be highly variable across health systems. Health systems that allocate resources and purchase software centrally may realize economies of scale with their purchases and have more bargaining power with vendors, which would enable greater adoption of advanced capabilities. In addition, they may have greater resources to invest in enterprise wide training. Existing research provides some empirical evidence of the impact of resources on HIT adoption in health systems[9], and there is also

evidence that information technology resources have driven adoption and success of other types of software systems in large enterprises[12].

Finally, there may be differences in the extent to which health systems standardize their use of technology. Health systems that standardize their EHRs will likely need to change fewer processes and deliver fewer different versions of training when rolling out new capabilities, which may enable greater adoption. While the link between enterprise wide technology standardization and adoption has not been empirically examined in health systems, researchers have documented the importance of enterprise wide architecture and standards for other information technology capabilities within large organizations[13].

Drawing on the conceptual model shown in Figure 1, the following three hypotheses were tested:

- H1: Compared to health systems that do not own and manage medical groups and hospitals, health systems that own and manage medical groups and hospitals will have greater adoption of advanced HIT capabilities.

- H2: Compared to health systems with decentralized resource allocation practices, health systems with more centralized resource allocation practices will have greater adoption of advanced HIT capabilities.

- H3: Compared to health systems with low EHR standardization, health systems with higher degrees of EHR standardization will have greater adoption of advanced EHR capabilities

METHODS

Data

Data from the system version of the 2017/2018 National Survey of Healthcare Organizations and Systems (NSHOS), a nationally representative sample of health care systems that took place from June 2017 to August 2018. The survey was based on previous surveys developed involving National Study of Physician Organizations[9,14] along with additional questions focusing on the use of biomedical innovations, patient engagement strategies, evidence-based care management and performance-based incentives. Respondents were the person most knowledge about the survey questions which most commonly were system Presidents, CEOs or Chief Medical Officers. Survey responses were matched with data obtained from IQVIA information services to provide additional context on systems' organizational characteristics. Of the 732 randomly sampled healthcare systems, 446 responded (60.9 percent completion), 425 of were included after data cleaning was completed. Given the strong financial incentives that the Meaningful Use Program created for basic EHR adoption, we eliminated systems that had not fully adopted basic EHRs (n=36). The final analytic sample includes 389 health care systems, 22.6% (n=88) of which were subsidiaries of corporate parents.

Measures

Outcome: Advanced HIT Adoption—Survey respondents were asked about the adoption and use of five advanced HIT capabilities across their health systems. Four of these capabilities--patients' access to their electronic medical records, patients' ability to electronically comment on their medical records, physicians' and patients' ability to communicate with each other via secure email, physicians' ability to know whether patients have filled prescriptions--are required capabilities for Certified Electronic Health Record Technology (CEHRT) designation[15]. The fifth, advanced analytic systems, has been identified in previous research as a key ingredient to successful care management for complex patients[16].

For each of these capabilities, respondents were asked how many hospitals or medical groups in their systems had the following features, with possible answers being "none," "some," "most," or "all." To construct a measure of successful advanced HIT adoption, we assigned answers of "most" or "all" one point, and "none" or "some" zero points. Overall adoption was then measured on a zero to five scale, with a score of zero indicating no capabilities had been adopted successfully, and a score of five indicating all capabilities were adopted successfully.

Predictor Variables—Health system ownership and management was measured via two survey questions that asked survey respondents about whether the system owned or managed hospitals and medical groups. Respondents had the option of answering "no," "own only," "manage only," and "own and manage." As we were sampling health systems, which by nature had a high level of medical group and hospital ownership and management (nearly 50% of the systems in our sample reported both owning and managing hospitals and medical groups), a categorical variable was created, assigning a value of 1 to systems that owned and managed hospitals and medical groups and 0 to all other systems.

The degree to which a health system allocated resources centrally was measured based on answers to three questions in the survey based on their ability to serve as potential proxies for resources that could be dedicated to new health IT systems. The questions were "What level of financial planning and revenue sharing best describes your healthcare system?", "At what level [is capital budgeting] primarily conducted?" and "At what level [is IT vendor selection] primarily conducted?". We assigned a point value of 1 for each activity conducted at the system level (and 0 for those conducted locally or regionally), and took an unweighted average of the point values across the three questions to develop an index of how much resource allocation was centralized (0 being none of these activities conducted at the system level, 1 being all activities conducted at the system level).

Electronic health record standardization was measured using answers to two questions: "How many EHR systems do you have in place across your hospitals' primary care groups?" and "to what extent are EHR data elements standardized?" Fully standardized EHR data elements and a single EHR system were each assigned a point value of 1, and we took an unweighted average of the point values across the two questions to develop an index of how much their EHR systems were standardized.

Control Variables—Previous research has found that alternative payment model (APM) participation is correlated with both more integrated organizational structures[17] and higher levels of HIT adoption[18]. We controlled for APM experience, which was measured by the total number of APMs that most or all of the system's hospitals and medical groups were participating in. We also controlled for relative size (standardized to a mean of 0 and standard deviation of 1), as measured by the number of physicians in the system, and whether respondents perceived there to be high levels of competition in either inpatient or outpatient settings. We also control for each system's geographic region based on the U.S. Census, which include South, Midwest, Northeast, West or Multi-Region based on the states in which they operated.

Analyses

Descriptive analyses of all key study variables were conducted, including a breakdown of advanced HIT adoption, organizational structure, EHR standardization, and resource allocation practices by number and percentage of systems. All three hypotheses were tested simultaneously using multivariate regression models that examined the association of organizational structure, resource centralization and EHR standardization and advanced HIT adoption, controlling for system size, perceived competition, region, corporate parent status, and alternative payment model experience. Results were weighted to account for differential selection probabilities resulting from probability sampling of systems based on organizational complexity, including having a subsidiary or not.

RESULTS

Table 1 provides descriptive statistics for key study variables. Adoption of advanced HIT capabilities was variable, with a mean of 2.4 capabilities adopted and most systems in our sample (80.5%) adopting between one and four features. Only 8.4% of systems in our sample reported adopting all five advanced HIT capabilities. Adoption rates varied widely by feature, with over 75% of systems having the ability of patients to access their medical records, but less than 32% reporting the ability of physicians to know when patients fill prescriptions and for patients to comment on their medical records.

Just under half of the systems in our sample (48.8%) owned and managed their hospitals and medical groups. They also allocated resources centrally—67.3% reported conducting capital budgeting at the system level, and 78.9% reported conducting vendor selection at the system level. Most systems used a single EHR (69.0%) and standardized EHR data elements (58.6%), although just under half reported standardized data elements *and* the use of a single EHR (48.1%). Alternative payment model experience varied, with the lowest rate of participation being in risk bearing ACOs (21.5%) and the highest rate of participation being in primary care improvement and pay for performance programs (60.4%).

Multivariate regression results indicate that the degree of EHR standardization (β= 0.76, p =0.001) was the strongest predictor of advanced HIT adoption, supporting our third hypothesis, as was system management and ownership of hospitals and medical groups (β= 0.32, p=0.04), supporting our first hypothesis. The degree of centralized resource allocation was not a significant predictor of advanced HIT adoption (β =0.42, p=0.13). Of our control

variables, alternative payment model experience was a significant predictor of advanced HIT adoption (β =0.10, p=0.03), as was size (β =0.13, p=0.006), but other variables were not significant.

DISCUSSION

Our findings have several implications for the further adoption of advanced HIT capabilities by health systems. First, the strongest predictor of advanced HIT adoption in a health system is the extent to which EHR systems are standardized. The second is that ownership and management of hospitals and medical groups is also a significant predictor of advanced HIT adoption. The third is that system resource allocation practices are less significant predictors of advanced HIT adoption when controlling for other organizational characteristics. While previous studies suggest that resources and economies of scale are the primary drivers of HIT adoption among medical groups and hospitals, we found that EHR standardization, rather than centralized resource allocation, was the strongest predictor of advanced HIT adoption across a heath care system.

There are several reasons why standardization may have a much stronger association with advanced HIT adoption than resource centralization in our study. The first is that our focus was specifically on health systems, which by nature are more centralized and well-resourced organizations than independent hospitals and medical groups. The second is that the adoption of advanced EHR capabilities may represent more of a challenge of change management than resource allocation. All the systems in our analytic sample had already acquired EHRs, and four of the five capabilities in question were required capabilities of EHR systems for Certified Electronic Health Record Technology designation. Third, health systems may decide to standardize their EHR systems in order to adopt advanced capabilities in the future, which the cross-sectional nature of our study could not address.

Our findings indicate that health systems that aim to accelerate the adoption of advanced HIT capabilities may benefit from standardizing their EHR systems across hospitals and medical groups within the system. The results related to resource allocation indicate that organizational forms with more distributed forms of resource allocation, but high levels of standardization, may achieve similar levels of advanced technology adoption. The findings also suggest that payers can assist health systems with EHR adoption by targeting technical assistance toward health systems with lower levels of EHR standardization. Moreover, health IT vendors may consider developing ways to standardize use of their products across systems to ensure greater adoption of new and beneficial features.

The results should be considered in light of some limitations. First, the cross-sectional nature of the NHSOS cannot establish the temporal ordering of any associations found. Second, NSHOS is a single-informant survey, which may impact the internal validity of the study. Self-reported data are sometimes inaccurate, and it is possible that the reliability with which systemwide standardization, resource allocation and HIT capabilities are reported varies by respondent. Third, data limitations prevented us from controlling for additional factors that may influence advanced HIT adoption, such as patient mix. Finally, we include measures of centralized resource allocation, but the specific resources available for investment in training

and software upgrades were not assessed. Questions about targeted HIT investments would be useful to include in future research.

In conclusion, the degree of electronic health record standardization within health systems, as measured by the degree of uniformity of technology systems and data elements across hospitals and medical groups, is a stronger predictor of advanced health information technology adoption than the system's ownership and management structure, resource allocation practices, or alternative payment model participation. Health system leaders looking to improve the diffusion of new technologies should consider ways to better standardize their implementation and use of electronic health records to drive widespread adoption of and benefit from new features. Further research should assess the impact of health care system resources for training and software upgrades on the adoption of advanced HIT and determine the drivers of wide variability in the adoption of individual advanced HIT capabilities.

Acknowledgements:

REFERENCES

1. Burwell SM. Setting value-based payment goals--HHS efforts to improve U.S. health care. N Engl J Med. 2015;372(10):897–899. doi:10.1056/NEJMp1500445 [PubMed: 25622024]

2. Recent Progress In The Value Journey: Growth Of ACOs And Value-Based Payment Models In 2018 https://www.healthaffairs.org/do/10.1377/hblog20180810.481968/full/. Accessed August 17, 2018.

3. King J, Patel V, Jamoom E, DesRoches C. The Role of Health IT and Delivery System Reform in Facilitating Advanced Care Delivery. Am J Manag Care. 2016;22(4):258–265. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4878450/. Accessed October 10, 2018. [PubMed: 27143291]

4. Adler-Milstein J, Embi PJ, Middleton B, Sarkar IN, Smith J. Crossing the health IT chasm: considerations and policy recommendations to overcome current challenges and enable value-based care. Journal of the American Medical Informatics Association. 2017;24(5):1036–1043. doi:10.1093/jamia/ocx017 [PubMed: 28340128]

5. Adler-Milstein J, Holmgren AJ, Kralovec P, Worzala C, Searcy T, Patel V. Electronic health record adoption in US hospitals: the emergence of a digital "advanced use" divide. J Am Med Inform Assoc. 2017;24(6):1142–1148. doi:10.1093/jamia/ocx080 [PubMed: 29016973]

6. Berwick DM. Disseminating innovations in health care. JAMA. 2003;289(15):1969–1975. doi:10.1001/jama.289.15.1969 [PubMed: 12697800]

7. Rodriguez HP, McClellan SR, Bibi S, Casalino LP, Ramsay PP, Shortell SM. Increased Use of Care Management Processes and Expanded Health Information Technology Functions by Practice Ownership and Medicaid Revenue. Med Care Res Rev. 2016;73(3):308–328. doi:10.1177/1077558715613233 [PubMed: 26577227]

8. Bishop TF, Shortell SM, Ramsay PP, Copeland KR, Casalino LP. Trends in hospital ownership of physician practices and the effect on processes to improve quality. Am J Manag Care. 2016;22(3): 172–176. [PubMed: 27023022]

9. Wiley JA, Rittenhouse DR, Shortell SM, et al. Managing Chronic Illness: Physician Practices Increased The Use Of Care Management And Medical Home Processes. Health Affairs. 2015;34(1): 78–86. doi:10.1377/hlthaff.2014.0404 [PubMed: 25561647]

10. Kerrissey M, Satterstrom P, Leydon N, Schiff G, Singer S. Integrating: A managerial practice that enables implementation in fragmented health care environments. Health Care Manage Rev. 2017;42(3):213–225. doi:10.1097/HMR.0000000000000114 [PubMed: 27309190]

11. McAlearney AS, Robbins J, Kowalczyk N, Chisolm DJ, Song PH. The role of cognitive and learning theories in supporting successful EHR system implementation training: a qualitative study. Medical Care Research and Review. 2012;69(3):294–315. [PubMed: 22451617]

12. Morton N, Hu Q. The relationship between organizational structure and enterprise resource planning systems: a structural contingency theory approach. AMCIS 2004 Proceedings. 2004:498.

13. Boh WF, Yellin D. Using enterprise architecture standards in managing information technology. Journal of Management Information Systems. 2006;23(3):163–207.

14. Casalino L, Gillies RR, Shortell SM, et al. External Incentives, Information Technology, and Organized Processes to Improve Health Care Quality for Patients With Chronic Diseases. JAMA. 2003;289(4):434–441. doi:10.1001/jama.289.4.434 [PubMed: 12533122]

15. Electronic prescribing | HealthIT.gov. https://www.healthit.gov/test-method/electronic-prescribing. Accessed December 5, 2018.

16. Bates DW, Saria S, Ohno-Machado L, Shah A, Escobar G. Big data in health care: using analytics to identify and manage high-risk and high-cost patients. Health Aff (Millwood). 2014;33(7):1123–1131. doi:10.1377/hlthaff.2014.0041 [PubMed: 25006137]

17. Peiris D, Phipps-Taylor MC, Stachowski CA, et al. ACOs Holding Commercial Contracts Are Larger And More Efficient Than Noncommercial ACOs. Health Aff (Millwood). 2016;35(10): 1849–1856. doi:10.1377/hlthaff.2016.0387 [PubMed: 27702959]

18. Chukmaitov AS, Harless DW, Bazzoli GJ, Deng Y. Factors associated with hospital participation in Centers for Medicare and Medicaid Services' Accountable Care Organization programs. Health Care Manage Rev. 9 2017. doi:10.1097/HMR.0000000000000182

Takeaway Points:

- Health systems that own and manage medical groups and that standardize their electronic health record systems report greater adoption of advanced health information technology capabilities, such as predictive analytic tools and patient electronic health record access.

- Health system leaders looking to improve the rates of advanced technology adoption may consider ways to standardize their electronic health record systesm across organizations.
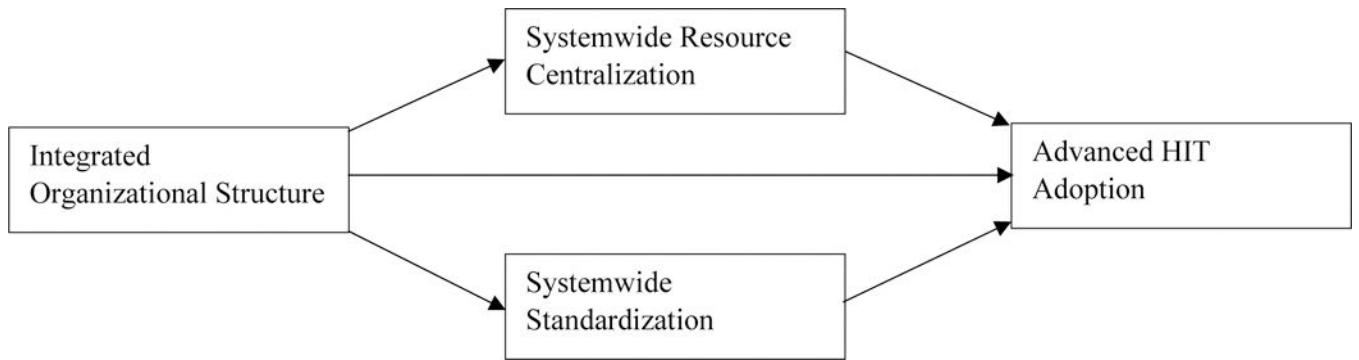
Figure 1:
Conceptual Model

Table 1:

Descriptive Health Care System Statistics for Key Study Variables [*]

Advanced HIT—Total Number of Features Adopted	Percentage of Systems	
• No features adopted	11.1%	
• One feature adopted	19.0%	
• Two features adopted	20.2%	
• Three features adopted	24.5%	
• Four features adopted	16.8%	
• Five features adopted	8.4%	
Advanced HIT—Adoption Rates by Feature	**Yes**	**No**
• Patients can access medical records	78.6%	21.4%
• Patients can comment on medical records	31.7%	68.3%
• Physicians/patients communicate via secure email	66.2%	33.8%
• Physicians know when patients fill prescriptions	31.6%	68.4%
• System uses advanced analytic systems	34.2%	65.8%
Organizational Structure		
• Own and Manage Medical Groups and Hospitals	48.8%	51.2%
• Corporate Parent	75.8%	24.2%
Resource Allocation Practices		
• Financial planning at system level	52.3%	47.7%
• Capital budgeting at system level	67.3%	32.7%
• HIT vendor selection at system level	78.9%	21.1%
Standardization Practices		
• Has a Single EHR	69.0%	31.0%
• Standardizes EHR data elements	58.6%	41.4%
• Uses single EHR and standardizes data elements	48.1%	51.2%
• Uses single EHR or standardizes data elements	79.6%	20.4%
Competition (Composite)		
• High perceived competition (outpatient)	47.2%	52.8%
• High perceived competition (inpatient)	47.5%	52.5%
System Wide Alternative Payment Model Experience		
• Bundled or episode-based payments	24.8%	75.2%
• Primary Care Improvement/Support Programs	55.6%	44.4%
• Pay for Performance Programs	55.6%	44.4%
• Capitated Contracts	26.4%	73.6%
• Medicare ACO (non-risk)	34.7%	65.3%
• Medicare ACO (risk-bearing)	21.5%	78.5%
• Medicaid ACO	22.8%	77.2%
• Commercial ACO	25.0%	75.0%

*Results weighted to account for differential sampling probabilities

HIT= Health Information Technology

EHR = Electronic Health Record

ACO = Accountable Care Organization

Table 2:

Organizational Factors Associated with Advanced HIT Adoption by Health Care Systems

Variable (range)	Coeff.	Std. Error	T Statistic	P value
Ownership and management of hospitals and medical groups (0–1)	0.32	0.15	2.11	0.04
Centralized resource allocation (0–1)	0.42	0.27	1.53	0.13
Electronic Health Record Standardization (0–1)	0.76	0.22	3.47	0.001
Number of active Alternative Payment Models (0–8)	0.10	0.05	2.17	0.03
Perceived competition (0–1)	−0.02	0.17	0.23	0.81
Size (standardized)	0.19	0.10	1.97	0.05
Corporate Parent Status	−0.18	0.18	−1.02	0.31
Constant	1.34	0.30	4.51	<0.001

Dummy variables for US Census Region were also included as control variables