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Authors

Robinson, James C
Casalino, Lawrence P
Gillies, Robin R
et al.

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Financial Incentives, Quality Improvement Programs, and the Adoption of Clinical Information Technology

James C. Robinson, PhD, Lawrence P. Casalino, MD, PhD,† Robin R. Gillies, PhD,* Diane R. Rittenhouse, MD,‡ Stephen S. Shortell, PhD,* and Sara Fernandes-Taylor, BA**

Objective: Physician use of clinical information technology (CIT) is important for the management of chronic illness, but has lagged behind expectations. We studied the role of health insurers' financial incentives (including pay-for-performance) and quality improvement initiatives in accelerating adoption of CIT in large physician practices.

Methods: National survey of all medical groups and independent practice association (IPA) physician organizations with 20 or more physicians in the United States in 2006 to 2007. The response rate was 60.3%. Use of 19 CIT capabilities was measured. Multivariate statistical analysis of financial and organizational factors associated with adoption and use of CIT.

Results: Use of information technology varied across physician organizations, including electronic access to laboratory test results (medical groups, 49.3%; IPAs, 19.6%), alerts for potential drug interactions (medical groups, 33.9%; IPAs, 9.5%), electronic drug prescribing (medical groups, 41.9%; IPAs, 25.1%), and physician use of e-mail with patients (medical groups, 34.2%; IPAs, 29.1%). Adoption of CIT was stronger for physician organizations evaluated by external entities for pay-for-performance and public reporting purposes ($P = 0.042$) and for those participating in quality improvement initiatives ($P < 0.001$).

Discussion: External incentives and participation in quality improvement initiatives are associated with greater use of CIT by large physician practices.

Key Words: information technology, medical groups, pay-for-performance, chronic illness, physicians

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Use of information technology is central to efforts to improve the quality, safety, and efficiency of health care services, but adoption in physician practices has lagged behind other sectors in the United States.[1–8] We use the term clinical information technology (CIT) to cover electronic medical records and other patient-care uses and to distinguish them from the more common billing and administrative functions. Although the literature contains many discussions of factors that potentially influence adoption of CIT in the United States, there are no studies on a national scale that provide quantitative analysis of the importance of factors on adoption across the full range of CIT capabilities.[9]

We hypothesized that adoption by physician organizations of CIT would be more extensive in contexts where the organization faced direct external incentives (eg, pay-for-performance) and where it faced indirect incentives in the form of participation in quality improvement initiatives that require good data for success. Considerable debate exists concerning the role, if any, of direct and indirect financial incentives for physician adoption and use of clinical information technology. Direct incentives come through pay-for-performance initiatives that measure the extent of CIT adoption and reward with financial bonuses those organizations with specific capabilities in use. Indirect incentives come through pay-for-performance and related initiatives that measure and reward the achievement of specified quality scores, under the assumption that success on these measures is more likely for organizations that possess robust electronic capabilities. Indirect incentives also may flow from the medical group's participation in quality improvement collaboratives, which rely on electronic collection and analysis of data for success. Physician organizations committed to collecting and analyzing patient experience data to improve performance also may be more likely than other physician practices to invest in information technology capabilities. Managed care, aside from pay-for-performance programs, could either accelerate or decelerate medical group investments in CIT. Although capitation and other HMO payment and administrative mechanisms increase the need by medical groups for data on their own performance, thereby spurring CIT adoption, these mechanisms also may reduce total revenues and thereby impede investments.

METHODS

The data for this analysis derive from the second round of the National Study of Physician Organizations (NSPO), the major focus of which has been the use of chronic care management processes for asthma, congestive heart failure, depression, and diabetes, and the organizational factors asso-

From the *University of California, School of Public Health, Berkeley, California; †Department of Public Health, Weill Cornell Medical College, New York, New York; and ‡Department of Family and Community Medicine, University of California, San Francisco, California.

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Reprints: James C. Robinson, PhD, University of California, School of Public Health, Berkeley, CA 94720-7360. E-mail: james.robinson@berkeley.edu.

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ciated with that use. The second-round survey instrument (NSPO 2) used to collect the data was based on that used for the first round. Casalino et al[4] discuss the development and testing process of the initial survey, which included literature review, focus group feedback, and pilot testing. For the second NSPO survey, the results of which we present here, we conducted a pilot test of the revised survey instrument with 14 physician organizations to make sure that the relatively minor changes made to the first-round instrument did not negatively impact the ability of respondents to understand and respond to the questions posed. Both first- and second-round survey instruments are available at the NSPO web site (http://nspo.berkeley.edu/).

We developed a list of all medical groups and IPAs in the United States with 20 or more physicians, based on information from the Medical Group Management Association,[10] Cattaneo and Stroud,[11] Dorland Healthcare Information,[12] and the Integrated Healthcare Association.[13] The sampling frame was focused on medical groups with 20 or more physicians as these are more likely than small practices to have the requisite resources to invest in clinical information technology, and on independent practice associations (IPAs), as these offer the potential for supporting CIT adoption in small physician practices. IPAs in the United States bring together numerous solo and small group practices for purposes of contracting with health insurance plans and, in some cases, for quality improvement purposes.[14] Physician entities associated with academic medical centers (eg, faculty practice plans) and physician groups that do not treat at least one of 4 major chronic illnesses (asthma, diabetes, congestive heart failure, depression) were excluded.

Of the 1520 physician organizations identified, 1162 were able to be contacted to ascertain whether they met study criteria. Of these, 480 were ineligible to participate because they did not meet study criteria, resulting in an eligibility estimate of 58.7% (682/1162). This eligibility estimate was applied to the 358 organizations that we were not able to contact, after multiple attempts, to verify that they met the study's eligibility criteria, producing an estimated 210 eligible organizations (0.587×358) from among those we were unable to contact. The total number of eligible organizations hence was calculated to be 892 ($210 + 682$). This approach to estimating potential respondents is standard for studies where the eligibility of nonrespondents cannot be verified, permitting the generation of an adjusted response rate calculated as number of respondents divided by the sum of respondents and the estimated number of nonrespondents that met study criteria.[15,16]

The medical director or chief administrator of every organization fitting the study criteria was contacted and asked to participate in a 35-minute structured survey. Respondents were reimbursed $150 for the value of their time. A total of 338 medical groups and 200 IPAs participated in the study, for an adjusted response rate of 60.3% (538/892). Interviews were conducted by telephone between March 2006 and March 2007. There were no statistically significant differences in response rates across geographic regions or between medical groups and IPAs.

The survey queried medical group and IPA leaders concerning 7 categories of electronic data and information technologies, building on the classification proposed by the Institute of Medicine.[17] These categories include electronic documentation; access to clinical data at the point of care; clinical decision support; physician order entry; electronic registries for patients with chronic illness; electronic connectivity with patients; and quality measurement. Respondents were asked whether the electronic documentation, access to clinical data, and electronic connectivity capabilities were actually used by a "majority" of the physician in the practice, not merely whether the capabilities were available to the physicians. Respondents were allowed to define for themselves what constitutes active use of an information technology and what constitutes a majority of physicians in their practices. To obtain a comprehensive view of the organization's information technology, we created an index that sums the number of distinct electronic capabilities and hence ranges on a scale from 0 to 19.

We use several variables to capture direct and indirect incentives. One question asks whether the physician organization is evaluated by health insurance plans and employers on the basis of use of information technology specifically, whereas a second queries whether they are evaluated on the basis of quality indicators. Health plan evaluations of physician practices are used as the basis for pay-for-performance and public performance reporting; in this study, we used "evaluated by" questions as indicators of eligibility for these programs. Other dimensions of financial incentives and pressures were measured in terms of the percentage of patients for which the practice was paid on a prospective, capitation basis for physician and hospital costs (as distinct from on a retrospective, fee-for-service basis), the percentage of patients enrolled in HMO insurance coverage, the distribution of patient coverage across the principal types of insurance (commercial insurance, Medicare, Medicaid, no insurance), and whether the practice earned a profit in the most recent fiscal year.

We queried physician organizations as to whether they were involved in any of 4 specified national quality improvement initiatives, including Bridges to Excellence,[18] the IHI Quality Collaborative,[19] Pursuing Perfection,[20] and Improving Chronic Illness Care.[21] These initiatives are sponsored by leading purchaser and professional associations. We also queried survey respondents whether they participated in any other quality improvement initiatives (which are mostly sponsored by regional health insurance plans). We created a dichotomous variable that indicates whether the physician organization participates in any quality improvement initiative, regional or national.

The extent to which the physician organization maintained a patient-centered focus was measured through an index structured on a scale of 1 to 5, derived from the Baldrige National Award Program, a widely used approach to measuring organizational performance.[22,23] Points on the patient-centered scale were assigned based on whether the organization assesses patient needs and expectations, promptly resolves complaints, studies patterns of complaints

to prevent recurrence, uses patient data to improve care, and uses patient data when developing new services. The scale ranged from a possible minimum of zero to a possible maximum of 5.

We measured organizational size in terms of 4 categories based on the number of affiliated physicians. Based on the existing literature on CIT adoption and preliminary analyses of our data that showed information technology adoption to rise very steeply in the largest medical groups, we created 1 category for the largest decile of physician organizations and 3 additional categories each containing approximately 30% of the organizations. This produced 4 categories by size and a total of 8 categories overall (4 for medical groups, 4 for IPAs). We also measured whether the physician practice was owned by a larger entity (hospital or HMO) or by the physicians themselves, whether it earned a profit or suffered a loss in the previous fiscal year, and the distribution of its annual revenue across 4 payer categories (commercial insurance, Medicare, Medicaid, and patient self-payment).

Multivariate statistical analyses were performed using the index of 19 CIT capabilities as dependent variable and the measures of financial incentives, quality improvement initiatives, patient-centered focus, practice size, ownership, payer mix, and profitability as independent variables.

RESULTS

Table 1 presents the percentage of medical groups and IPAs, respectively, in which the physicians have adopted CIT capabilities. Of the 19 capabilities studied, the average number adopted is 6.8 for medical groups and 3.5 for IPAs. For medical groups, 42% have capabilities for documentation and approximately one-third have decision support capabilities; considerably higher percentages have electronic patient records that include laboratory and radiology test results. Medical group access to electronic data on filled prescriptions is substantially lower, as these derive usually from pharmacy benefit management firms that contract with and report to insurers, not physician organizations. Electronic prescribing capabilities are present in 42% of medical groups. Electronic registries with information on patients with chronic conditions range from a high of 51% for diabetes to a low of 24% for depression. Patients can access part of their electronic medical record online in only 8% of medical groups but can communicate with their physicians using e-mail in a third of the organizations.

CIT capabilities are less likely to be used by physicians participating in IPAs than by those employed by medical groups, as indicated in the second column of Table 1. Adoption is lowest for those forms of information technology that must be integrated into the private practices of their participating physicians but higher for electronic registries, prescribing capabilities, and physician-to-patient e-mail capabilities, which can be hosted at the level of the IPA itself. The lower rates of adoption in IPAs compared with medical groups could be due to lower offer rates by the organization, lower acceptance rates by the participating physicians, or both. Almost all the differences in prevalence between integrated medical groups and IPAs are statistically significant using 2-tailed tests, as indicated in the third column of the Table, with the exception of the prevalence of registries for several chronic conditions and the use by physicians of e-mail with their patients.

TABLE 1. Information Technology Capabilities and Electronic Medical Records in Large Physician Organizations, 2006 to 2007

	Medical Groups (N = 338)	Independent Practice Associations (N = 200)	*P*
Electronic documentation			
Ambulatory care progress notes	42.5%	9.5%	0.000
List of patient medications	42.5%	11.6%	0.000
Electronic access to clinical data			
Laboratory test results	49.3%	19.6%	0.000
Radiology results	46.0%	15.6%	0.000
Specialist referral notes	35.4%	5.0%	0.000
Emergency department notes	33.6%	9.0%	0.000
Hospital discharge summaries	39.8%	13.6%	0.000
Record of prescriptions filled	18.3%	4.5%	0.000
Clinical decision support			
Alerts for potential drug interactions	33.9%	9.5%	0.000
Alerts for abnormal test results	32.7%	10.1%	0.000
Prompts at time of patient visit	28.9%	11.6%	0.000
Physician order entry			
Physician electronic prescribing	41.9%	25.1%	0.000
Electronic registry for chronic illness			
Diabetes	51.0%	48.2%	0.533
Asthma	31.9%	46.2%	0.001
Congestive heart failure	37.2%	37.7%	0.904
Depression	23.6%	19.6%	0.273
Electronic connectivity for patients			
Physicians use e-mail with patients	34.2%	29.1%	0.220
Patients can access part of EMR online	8.0%	2.0%	0.001
Quality measurement			
EMR used to measure quality	46.0%	20.6%	0.000
Index of all 19 IT capabilities–mean (SD)	6.8 (5.8)	3.5 (3.5)	0.000

Table 2 presents descriptive statistics on physician organizations. Large medical groups and IPAs in the United States are heavily involved in programs that evaluate use of information technology for pay-for-performance and public reporting purposes. Approximately half participate in a quality improvement program sponsored by a regional health

insurance plan or nationally recognized program. The average score of the physician organizations on the 5-point index indicating use of patient experience to improve organizational performance was 4.0 for medical groups and 3.6 for IPAs.

As indicated in Figure 1, adoption of the 19 information technology capabilities increases strongly with size for medical groups, with the average number of capabilities rising from 4.3 for groups with 20 to 87 physicians to 12.2 for the largest groups. Only a modest size gradient for information technology adoption is evident for IPAs, with the average number of capabilities rising from 2.8 in the smallest IPAs up to 4.0 for the largest. The size gradient is statistically significant for medical groups (as measured by regression of the CIT index on size category variables; not shown) but not for IPAs.

TABLE 2. Size, Structure, Payer Mix, and Other Characteristics of Large Physician Organizations

	Medical Groups	Independent Practice Associations
Evaluated by insurers or other entities for use of information technology	46.0%	65.3%
Evaluated by insurers or other entities for quality	79.9%	87.4%
% revenue from capitation	8.4%	21.7%
% revenue from HMO	43.1%	79.0%
Participates in quality improvement programs	59.0%	45.2%
Patient-centered culture index-mean (SD)	4.0 (0.5)	3.6 (0.7)
Payer mix (annual revenue)		
Commercial	51.5%	57.0%
Medicare	29.3%	18.7%
Medicaid	12.6%	23.4%
Self-pay/Uninsured	6.6%	0.9%
Group earned a surplus	56.3%	68.8%
Owned by hospital or HMO	32.2%	9.0%
Size categories: no. physicians		
Small (20–40 for MG; 20–122 for IPA)	31.0%	29.6%
Medium (41–87 for MG; 123–320 for IPA)	31.3%	30.2%
Large (88–440 for MG; 321–800 for IPA)	29.2%	30.2%
Very large (more than 440 for MG; more than 800 for IPA)	8.6%	10.1%

MG indicates medical group; IPA, Independent Practice Association.

Table 3 presents multivariate regression coefficients for the adoption of CIT, using as dependent variable the index of 19 electronic capabilities. Physician organizations that are subject to evaluation by outside entities for use of information technology adopt more electronic capabilities than do otherwise similar organizations not subject to evaluation ($P = 0.042$). However, evaluation by outside entities based on measures of quality (such as screening rates for diabetic retinopathy) does not show a statistically significant association. Physician organizations that participate in formal quality improvement programs report an average of 1.9 more information technology capabilities than other physician organizations ($P < 0.001$). Organizations that rank higher on the patient-centered index are more likely to adopt electronic capabilities than those that do not ($P = 0.005$), with each unit increase along the 5-point scale associated with adoption of one additional electronic capability.

Physician organizations in the United States that face capitation payment are more likely to adopt informational capabilities than otherwise similar organizations paid solely by fee-for-service ($P = 0.009$). Adjusting for capitation incentives, however, medical groups and IPAs with a high fraction of patients enrolled in HMOs are significantly less likely to adopt information technology capabilities than are organizations whose patients are mostly enrolled in non-HMO insurance products ($P = 0.011$). Although statistically significant, the size of the association between managed care and information technology adoption is small.

DISCUSSION

This study documents the prevalence of 19 CIT capabilities in large physician organizations and quantifies the role of organizational and market characteristics in promoting adoption. Almost half of medical groups report that their physicians have electronic access to radiology and laboratory test results. Over a third report physician access to, and use of, automatic alerts for potential drug interactions and abnormal test results, and over 40% report that the majority of their physicians have the ability to transmit prescriptions electronically to pharmacies, a capability sometimes considered the

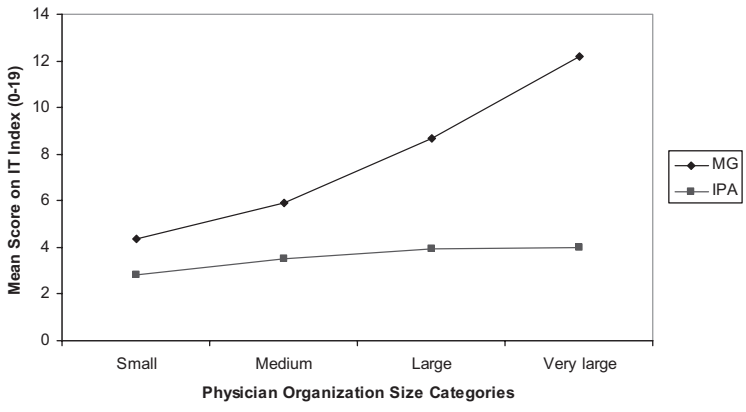

FIGURE 1. Information technology capabilities by organization size.

TABLE 3. Association between External Incentives, Organizational Characteristics, and the Adoption of Clinical Information Technology Capabilities in Large Physician Practices

	Index of all 19 Information Technology Capabilities		
	B	**(95% CI)**	***P***
Evaluated by insurers or other entities for use of information technology	0.98	(0.03 ± 1.92)	0.042
Evaluated by insurers or other entities for quality	0.18	(−1.02 ± 1.38)	0.770
% revenue from capitation	0.02	(0.01 ± 0.04)	0.009
% revenue from HMO	−0.02	(−0.03 ± −0.01)	0.011
Participates in quality improvement programs	1.89	(1.00 ± 2.77)	0.000
Uses patient feedback to analyze, improve services	1.01	(0.31 ± 1.72)	0.005
Payer mix (annual revenue):			
Medicare (%)	0.01	(−0.01 ± 0.04)	0.356
Medicaid (%)	−0.02	(−0.04 ± 0.00)	0.081
Self-pay/uninsured (%)	−0.01	(−0.06 ± 0.05)	0.845
Group earned a surplus	0.06	(−0.84 ± 0.96)	0.896
Owned by hospital or HMO	0.32	(−0.74 ± 1.38)	0.551
Size by type categories			
Medical group: medium (41–87 MD)	1.48	(0.17 ± 2.79)	0.027
Medical group: large (88–440 MD)	3.75	(2.38 ± 5.12)	0.000
Medical group: very large (more than 440 MD)	6.44	(4.32 ± 8.57)	0.000
IPA: small (20–122 MD)	−0.24	(−1.95 ± 1.48)	0.787
IPA: medium (123–320 MD)	−0.34	(−2.01 ± 1.33)	0.691
IPA: large (321–800 MD)	0.47	(−1.23 ± 2.17)	0.587
IPA: very large (more than 800 MD)	0.18	(−-2.28 ± 2.65)	0.883
Constant	−0.62	(−3.69 ± 2.45)	0.692
Adjusted R^2	0.28		

one offering the most immediate benefits in improved patient safety and practice efficiency.[24] A third of medical group leaders report that the physician members of their organizations use e-mail to communicate with patients, consistent with survey data on individual physicians.[25]

The findings reported here are consistent with those reported in a recent article by DesRoches et al[26] based on a survey of CIT use among individual physicians. That study queried physicians concerning availability and use of a series of electronic information functions similar to those used in this study, consistent with the principle that it is imperative to focus on functions, individually and in combination, rather than simply on whether or not the physician or physician organization has access to a broadly or vaguely defined "electronic medical record." DesRoches et al find that physicians in large medical groups are 3 to 4 times more likely than those in solo and small practices to have access to basic or enhanced set of electronic functions, but that even the largest size category they use (physicians in groups with 50 or more physician members) only 17% have a full set of functions and only 49% have a basic set (these figures are similar to those presented in the first column of Table 1 in this article).

This study presents new findings on the organizational and market factors associated with medical group and IPA adoption of information technology capabilities. The evaluation of physician organizations by insurers and other outside entities for purposes of public reporting and pay-for-performance stimulate information technology adoption when they are focused specifically on information technology but not, apparently, when they are focused on measures of quality. As argued by the Medicare Payment Advisory Committee,[27] the long term goal of pay-for-performance programs is to encourage CIT adoption indirectly, by rewarding quality performance that presumes electronic data, rather than through direct bonuses for CIT adoption. However, the Massachusetts pay-for-performance program that rewards physician investments in information technology directly, and not only indirectly through bonuses for quality, significantly accelerated the adoption of electronic medical records.[28] The Integrated Healthcare Association program in California provides financial rewards for CIT adoption and has seen significant improvements in CIT use since its inception in 2003.[29] Our national results are consistent with the Massachusetts and California experiences in suggesting that direct rewards for information technology adoption provide a meaningful transition incentive on the road to quality-based reward programs.

We find a strong positive association between our measures of a physician organization's commitment to quality improvement, on the one hand, and its adoption of clinical information technology, on the other. The organization's commitment to quality improvement may derive from the organization's leadership, physician culture, and/or perception that quality improvement will benefit the organization in its local market position. The first measure of commitment to quality improvement indicates whether or not the physician organization participates in a quality improvement collaborative with an external entity. The second measure of commitment to quality improvement is an index, ranging from 0 to 5, indicating the extent to which the physician organization collects and uses data on its patient experience, as a means toward performance improvement. The strong association between each of these measures and CIT adoption supports the view that engagement in quality improvement stimulates demand for CIT, independent of financial incentives.

The effect of managed care on information technology is the sum of 2 different and directionally opposite factors. Capitation payment methods permit the physician organization to capture the financial benefits from savings that flow from better information technology, such as reductions in duplicative testing and remediation of adverse drug reactions.[30] Robust electronic capabilities are a prerequisite for the changes in organizational processes that are rewarded by capitation payment methods.[31] But HMOs often pay on a fee-for-service rather than capitation basis and at lower rates than other commercial insurance products, thereby reducing

the physicians' financial capability to invest in their practices. We controlled for whether the physician organization earned a profit or suffered a loss in its most recent fiscal year, but this is only a limited measure of its financial capabilities. It is interesting to highlight, in this context, that financial capability, as measured, is not associated with CIT adoption. This suggests that medical group adoption of CIT is associated with financial and nonfinancial incentives rather than with its ability to pay in the absolute sense. Our findings are consistent with a smaller 2001 study[32] that reported a positive association between capitation revenue and CIT adoption but no association between noncapitated managed care revenue and adoption of information technology.

Our findings should be considered within the study's limitations. These large medical groups and IPAs do not represent the majority of US physicians, who continue to practice solo or in small groups. The 60% response rate to this study, while consistent with other surveys of physician organization and CIT adoption, is modest. Campbell et al recently noted that responses rates from physician organizations are declining for all studies.[17] The data reported here are derived from interviews with physician leaders and responses may differ from those that would be obtained from practicing physicians. However, our findings are similar to estimates of actual physician use of electronic capabilities derived from a survey of individual physicians, providing confidence in the accuracy of our data.[33]

The findings reported here can be interpreted as a glass half empty or half full with respect to efforts to improve the quality and efficiency of care through clinical information technology. Although only a minority of physician organizations in the United States possesses all the components of an electronic medical record,[5,6,34,35] many organizations have adopted selected capabilities and can access selected types of clinical information. These physician organizations seem to be postponing full adoption while using those data elements and capabilities most relevant to their immediate needs. Future studies of the adoption of CIT should query the availability and use of specific functions, and not ask merely whether the physicians use an "electronic medical record." For the large physician organizations studied here, access to clinical records, especially laboratory and radiology test results, ambulatory visit notes, and medication lists, appear particularly important, followed by clinical decision support tools and registries for patients with the most prevalent chronic conditions. Empirical data on the sequence of adoption of functions may help guide organizational and policy initiatives seeking to accelerate the adoption of electronic capabilities.

The adoption and use of CIT responds to economic incentives and builds on organizational capabilities. As emphasized by prominent observers,[3,9,28] the long-term benefits of information technology will flow not from the conversion of existing paper data to digital format but, rather, from changes in the ways physicians organize their practices, balance evidence and experience in making clinical decisions, interact with their patients, and are reimbursed for their time and expertise. External incentives such as pay-for-performance and quality improvement programs have the potential to contribute to these important changes in the organization and financing of physician practice.

REFERENCES

1. Institute of Medicine. *Crossing the Quality Chasm: A New Health System for the 21st Century*. Washington, DC: National Academy Press; 2001.
2. Milstein A. Health information technology is a vehicle, not a destination: a conversation with David J. Brailar. *Health Aff*. 2007;26:w236–w241.
3. Blumenthal D, Glaser JP. Information technology comes to medicine. *N Engl J Med*. 2007;356:2527–2534.
4. 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;289:434–441.
5. Gans D, Kralewski J, Hammons T, et al. Medical groups' adoption of electronic health records and information systems. *Health Aff*. 2005;24:3123–1333.
6. Burt CW, Hing E, Woodwell D. Electronic medical record use by office-based physicians in the United States, 2005. US National Center for Health Statistics, Health-E Stats. Available at: http://www.cdc.gov/nchs/products/pubs/pubd/hestats/electronic/electronic.htm. Accessed July 20, 2007.
7. Jha AK, Ferris TG, Donelan K, et al. How common are electronic health records in the United States? A summary of the evidence. *Health Aff*. 2006;25:w496–w507.
8. Blumenthal D, Desroches C, Donelan K, et al. *Health Information Technology in the United States: The Information Base for Progress*. Princeton, NJ: Robert Wood Johnson Foundation; 2006.
9. Chaudhry B, Wang J, Wu S, et al. Systemic review: impact of health information technology on quality, efficiency, and costs of medical care. *Ann Intern Med*. 2006;144:742–752.
10. Medical Group Management Association. Available at: http://www.mgma.com. Accessed December 10, 2004.
11. Cattaneo and Stroud, Inc. Available at: http://www.cattaneostroud.com. Accessed December 10, 2004.
12. Dorland Healthcare Information. Physician Groups and Networks Database. Available at: http://www.dorlandhealth.com. Accessed February 10, 2005.
13. Integrated Healthcare Association. Available at: http://www.iha.org,. Accessed May 10, 2005.
14. Robinson J. *The Corporate Practice of Medicine*. Berkeley, CA: University of California Press; 1999.
15. American Association for Public Opinion Research. Standard definitions: final dispositions of case codes and outcome rates for surveys. Available at: http://www.aapor.org/uploads/standarddefs_4.pdf. Accessed October 25, 2007.
16. Campbell EG, Gruen RL, Mountford J, et al. A National survey of physician-industry relationships. *N Engl J Med*. 2007;356:1742–1750.
17. Institute of Medicine. *Key Capabilities of an Electronic Health Record System: Letter Report*. Washington, DC: National Academies Press; 2003.
18. Bridges to Excellence website. Available at: http://www.bridgestoexcellence.org/. Accessed October 25, 2007.
19. Institute for Healthcare Improvement website. Available at: http://www.ihi.org/IHI/Programs/InnovationCommunities/Collaboratives. Accessed October 25, 2007.
20. Institute for Healthcare Improvement website. Available at: http://www.ihi.org/IHI/Programs/StrategicInitiatives/PursuingPerfection.htm. Accessed October 25, 2007.
21. Improving Chronic Illness Care website. Available at: http://www.improvingchroniccare.org/. Accessed October 25, 2007.
22. 2007 Baldrige National Quality Program. Available at: http://www.baldrige.nist.gov/PDF_files/2007_HealthCare_Criteria.pdf.
23. Shortell SM, Marsteller JA, Lin M, et al. The role of perceived team effectiveness in improving chronic illness care. *Med Care*. 2004;42:1040–1048.
24. Grossman JM, Gerland A, Reed MC, et al. Physicians' experiences using commercial e-prescribing systems. *Health Aff*. 2007;26:w393–w404.
25. Liebhaber AB, Grossman JM. *Physicians Slow to Adopt Patient E-Mail*. Washington, DC: Center for Studying Health System Change; 2006. Data Bulletin: Results from HSC Research.

26. DesRoches CM, Campbell EG, Rao SR, et al. Electronic health records in ambulatory care: a national survey of physicians. *N Engl J Med*. 2008;359:50–60.
27. Hackbarth G, Milgate K. Using quality incentives to drive physician adoption of health information technology. *Health Aff*. 2005;24:1147–1157.
28. Foubister V. Case Study: Using Payment Incentives to Improve Care Delivery. Quality Matters: Payment Reform: 2007;25:4–8. New York: Commonwealth Fund.
29. Increased Use of Information Technology by California Physician Groups Supports Better Quality of Care. Available at: http://www.iha.org/Year4_2006_P4Presults_vfinal.pdf.
30. Wang SJ, Middleton B, Prosser LA, et al. A cost-benefit analysis of electronic medical records in primary care. *Am J Med*. 2003;114:397–403.
31. Berwick DM. Payment by capitation and the quality of care. *N Engl J Med*. 1996;335:1227–1231.
32. Furukawa MF, Ketcham JD, Rimsza ME. Physician practice revenues and use of information technology in patient care. *Med Care*. 2007;45:168–176.
33. Audet AM, Doty MM, Peugh J, et al. Information technologies: when will they make it into physicians' black bags? *Med Gen Med*. 2004;6:2–14. Available at http://www.medscape.org. Accessed July 20, 2007.
34. Simon SR, Kaushal R, Cleary PD, et al. Physicians and electronic health records. *Arch Intern Med*. 2007;167:507–512.
35. Reed M, Grossman J. *Growing Availability of Clinical Information Technology in Physician Practices*. Washington, DC: Center for Studying Health System Change; 2006. Data Bulletin, No. 31.