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# Electronic Health Records' Limited Successes Suggest More Targeted Uses

**ABSTRACT Understanding whether electronic health records, as currently adopted, improve quality and efficiency has important implications for how best to employ the estimated $20 billion in health information technology incentives authorized by the American Recovery and Reinvestment Act of 2009. We examined electronic health record adoption in U.S. hospitals and the relationship to quality and efficiency. Across a large number of metrics examined, the relationships were modest at best and generally lacked statistical or clinical significance. However, the presence of clinical decision support was associated with small quality gains. Our findings suggest that to drive substantial gains in quality and efficiency, simply adopting electronic health records is likely to be insufficient. Instead, policies are needed that encourage the use of electronic health records in ways that will lead to improvements in care.**

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The health care industry lags behind others in its use of technologies that promote high quality of service and efficient organizational processes. For years, policy makers have been optimistic that electronic health records could bring important improvements in the coordination and quality of care; generate cost savings by reducing redundant, error-prone care; and improve the overall efficiency of the health care system.[1,2]

Beginning in 2004, a series of major policy initiatives were launched, whose purpose was to drive the adoption of health information technology (IT). These initiatives, started during the George W. Bush administration, culminated in the enactment of the Health Information Technology Economic and Clinical Health (HITECH) Act as part of the American Recovery and Reinvestment Act (ARRA) of 2009.[3] ARRA authorizes an estimated $20 billion in direct grants and financial incentives to promote the adoption and meaningful use of electronic health records among health care providers.[3,4]

There is strong evidence that specific electronic health record functions, such as clinical decision support and computerized physician order entry, can improve quality,[5] reduce unnecessary tests,[6–8] and eliminate medication errors.[8,9] However, much of this evidence comes from a small number of high-performing institutions with electronic health record systems tailored to the organization's unique needs.[6,8,10] Evidence of the effect of electronic health records on quality and costs, beyond these pioneering institutions, has been limited.

ARRA set a requirement that institutions must demonstrate "meaningful use" of health IT before they can receive federal dollars to help pay for it. The federal government has now proposed regulatory language comprising twenty-five different measures of meaningful use in such areas as care coordination, privacy and security, quality, and safety. As the debate over what constitutes the meaningful use of health information technology continues, understanding whether

electronic health records as they are currently implemented affect hospital care quality and costs can help shape how policy makers approach efforts to promote their effective use.

Therefore, we used data from our recent national survey of electronic health record adoption among acute care hospitals to investigate the relationship between the adoption of electronic health records and key individual functions, and available measures of health care quality and efficiency. Specifically, we assessed whether electronic health record adoption was associated with better performance on standard process-of-care measures, lower mortality and readmission rates, shorter lengths-of-stay, and lower inpatient costs.

## Study Data And Methods

**RISK ADJUSTMENT OR RISK STANDARDIZATION** In this paper we use the terms "risk adjustment" and "risk standardization." Risk adjustment is used in analyses such as those described here to account for the fact that different hospitals take care of different types of patients. Some may care for more elderly patients, or sicker patients needing more complex care, relative to other hospitals. Risk adjustment or standardization accounts for these differences in patient mix, allowing for fairer comparisons across institutions. When we discuss mortality rates, "risk standardization" is used.

**DATA SOURCES** We used four primary sources of data to create key variables of interest: the 2008 American Hospital Association (AHA) hospital IT survey of U.S. acute care hospitals;[11,12] the 2008 AHA annual survey; the 2009 release of the Hospital Quality Alliance database; and the 2006 Medicare Provider Analysis and Review File.

The hospital IT survey was an Information Technology Supplement to the AHA's annual survey in 2008. The details of its development and administration have been described elsewhere.[11–13] Briefly, we used existing surveys to fashion a new instrument and partnered with the AHA to administer it. The survey was sent to hospitals' chief operating officers, who generally assigned the most knowledgeable person in the institution (generally the chief information officer or equivalent) to complete it.

The survey was administered to all acute care general medical and surgical member hospitals (4,840, equaling 97 percent of all U.S. community hospitals) during March–September 2008. We received completed surveys from 3,049 of them (for a 63 percent response rate).[12] Any hospital that did not return a completed survey was excluded from these analyses, as were federal hospitals and those located outside of the fifty states and the District of Columbia. This left us with 2,952 institutions to study.

**DEFINITIONS** We used the definition of *electronic health record* developed by the federally sponsored Expert Advisory Panel. This panel defined a "comprehensive" electronic health record as adoption of twenty-four clinical functions across all major clinical units in the hospital, and a "basic" one as adoption of ten key functions in at least one major clinical unit of the hospital. The specific functions included in these definitions are identified in Appendix Exhibit 1.[14]

**HOSPITAL CHARACTERISTICS** We linked the hospital IT survey data to data from the AHA's annual survey to obtain information on hospitals' bed size, census region, profit status, membership in the Council of Teaching Hospitals, location (urban versus rural), membership in a multihospital system, and presence of a cardiac intensive care unit. This survey reflects hospital characteristics in 2008.

**MEASURES OF QUALITY** To examine performance on quality metrics, we used data from the 1 September 2009 release of data from the Hospital Quality Alliance, which reported process measures for 4,460 acute care hospitals based on patients seen during calendar year 2008. Taking a widely deployed approach, we used these measures to create condition-specific summary scores for three conditions—acute myocardial infarction, congestive heart failure, and pneumonia—and prevention of surgical complications.[15] The specific indicators involved are listed in the Technical Appendix.[14]

We used the thirty-day risk-standardized mortality rate for acute myocardial infarction, congestive heart failure, and pneumonia as reported in the Hospital Quality Alliance public-release data described above. Mortality rates are calculated by the Centers for Medicare and Medicaid Services (CMS) using Medicare claims data.[16]

**MEASURES OF EFFICIENCY** We examined three commonly used measures of hospital efficiency: risk-adjusted length of stay, risk-adjusted thirty-day readmission rates, and risk-adjusted inpatient costs. For all three measures of efficiency, we used a risk-adjustment model that accounts for underlying differences in patient age, sex, race, and the presence or absence of thirty-one accompanying medical conditions.[17]

For the cost and efficiency analysis, we used two additional sources of data to identify hospital characteristics. One was the Medicare Inpatient Impact File, which we used to identify the teaching intensity of hospitals using the intern-and-resident-to-bed ratio and the Medicare wage index in a hospital's local community. Another was the Area Resource File, which we used to

obtain county-level variables, including poverty rate and the proportion of households with annual income less than $10,000.

For each efficiency measure, we first constructed an overall model for all hospitalizations among patients admitted for any medical or surgical condition. We then constructed models for acute myocardial infarction, congestive heart failure, and pneumonia. Our analytic approach to each of these is described below.

We calculated risk-adjusted length-of-stay and thirty-day readmissions for all hospitalizations and for our three specific conditions using the model described above.

For each hospital, we used a standard approach to calculating costs. We used Medicare data to estimate each hospital's observed costs (actual costs overall and for individual conditions) compared to each hospital's expected costs based on the average costs that all hospitals incur for treating similar patients. These models take into account the hospital's patient population (that is, the sickness of its patients), its mission (that is, whether it takes care of a largely poor population), as well as community factors outside its control (that is, location in a high-wage area such as New York City).[18,19] For each hospital we created a ratio of observed (actual) over expected costs. A ratio of 1.0 means that a hospital's actual costs were equal to its expected costs. A ratio of 1.1 would mean that its costs were 10 percent higher than would be expected given its case-mix, mission, and location.

**ANALYSIS** As previously reported, we found slight differences between hospitals that did and did not respond to the IT survey.[12] All analyses reported below were weighted to account for these differences attributable to nonresponse.

▶ **QUALITY OF CARE:** We began by examining whether hospitals with comprehensive, basic, or no electronic health record systems had higher performance on Hospital Quality Alliance summary scores and lower thirty-day risk-standardized mortality rates for the four conditions described above. We used multivariable models to adjust for key hospital characteristics such as size or teaching status. These variables were chosen because evidence suggests that hospitals' adoption rates varied based on these characteristics; prior work has shown that these variables may also be associated with differences in quality or efficiency.[20]

▶ **EFFICIENCY AND COST OF CARE:** We used a similar approach and examined whether hospitals that had adopted comprehensive, basic, or no electronic health records differed in their overall risk-adjusted length-of-stay, thirty-day readmissions, or inpatient costs. We then used multivariable models to adjust for the key hospital characteristics. We repeated this analytic approach for each of the individual conditions, examining the outcomes by level of electronic health record adoption.

▶ **ADOPTION OF SPECIFIC FUNCTIONS:** Finally, we examined associations between the availability of specific electronic health record functions and our quality and efficiency measures. We assumed, based on the existing evidence, that the availability of two specific types of clinical decision support—clinical reminders and clinical practice guidelines—as well as computerized physician order entry for medications would be most helpful to hospitals in helping them improve performance on our outcome measures.[8,21] We used an analytic approach identical to the one described above.

## Study Results

**QUALITY OF CARE** We found no significant relationship between electronic health record adoption and quality process measures for acute myocardial infarction, congestive heart failure, or pneumonia (Exhibit 1). However, we did find that hospitals with electronic health records had somewhat better performance on prevention of surgical complications (93.7 percent for hospitals with a comprehensive electronic health record, 93.3 percent for those with a basic electronic health record, and 92.0 percent for those without an electronic health record. (Statistically, these results carry a $p$ value of 0.01, which means that they almost certainly suggest a real relationship and did not occur because of chance.) We found no significant relationship between electronic health records and thirty-day risk-standardized mortality for the conditions examined (Exhibit 2).

**COSTS AND EFFICIENCY OF CARE**

▶ **LENGTH-OF-STAY:** We found no relationship between the level of electronic health record adoption and overall risk-adjusted length-of-stay (Exhibit 3). When we examined length-of-stay for individual conditions, we did find that for one condition only, pneumonia, patients in hospitals with a comprehensive electronic health record had a length-of-stay that was, on average, 0.5 days shorter than those of patients in hospitals without electronic health record systems (here, the $p$ value for differences across all three groups is 0.003, which again means that these results were not likely to be the result of chance).

▶ **RISK-ADJUSTED THIRTY-DAY READMISSION RATES:** Hospitals with comprehensive electronic health record systems had similar rates of readmissions within thirty days of hospital discharge compared to hospitals with basic or no electronic health records. There were no signifi-

**EXHIBIT 1**

**Hospitals' Quality Metrics For Four Health Conditions, By Hospitals' Level Of Electronic Health Record (EHR) Adoption, 2008**

| | Hospital Quality Alliance summary scores (%) | | | |
|---|---|---|---|---|
| | AMI | CHF | Pneumonia | SCIP |
| Comprehensive EHR adoption | 97.5 | 91.2 | 93.2 | 93.7 |
| Basic EHR adoption | 96.4 | 90.5 | 92.9 | 93.3 |
| No EHR adoption | 96.3 | 89.1 | 92.4 | 92.0 |
| *p* value | 0.24 | 0.08 | 0.33 | 0.01 |

**SOURCE** Authors' analyses of data from the Hospital Quality Alliance (HQA) program; the American Hospital Association annual survey; and the AHA Hospital IT Survey of Acute Care Hospitals in the U.S., 2008. **NOTES** HQA scores were obtained using multivariable models that adjusted for hospital characteristics. AMI is acute myocardial infarction. CHF is congestive heart failure. SCIP is Surgical Care Improvement Project measures. Comprehensive EHR adoption denotes that EHRs were fully adopted in all major clinical units of the hospital. Basic EHR adoption denotes that EHRs were fully adopted in at least one but not all major clinical units of the hospital.

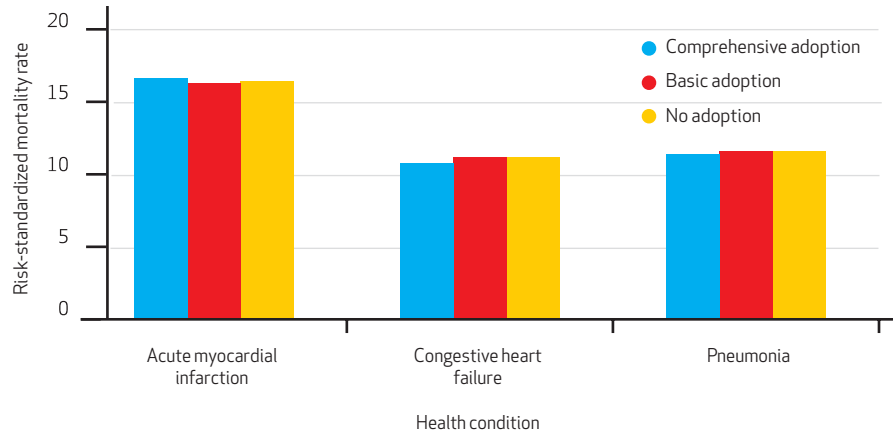
cant differences in the rates of readmission for any of the individual conditions examined.

▶ **RISK-ADJUSTED TOTAL COSTS:** Exhibit 3 displays the observed-to-expected cost ratios, a measure of how much a hospital's total costs vary from what would be expected given its patient mix, by level of electronic health record adoption. Overall, we found that hospitals with such systems had comparable inpatient costs to hospitals without them (Exhibit 3). For example, hospitals with a comprehensive electronic health record had, on average, costs that were 2 percent lower than expected (observed-to-expected cost ratio of 0.98), while those without such systems had observed costs that were 1 percent higher than expected (observed-to-expected cost ratio of 1.01; here the *p* value is 0.22, which signals that there is no significant relationship between electronic health record adoption and risk-adjusted total costs). We found no significant differences in risk-adjusted cost ratios for any of the three conditions examined.

**PROCESSES AND OUTCOMES** When we examined the availability of individual clinical functions and performance on quality metrics, we found a consistent pattern. The availability of computerized physician order entry for medications and individual clinical decision-support tools—clinical reminders and clinical practice guidelines—was generally associated with marginally better performance on each of the Hospital Quality Alliance quality metrics (Exhibit 4).

**EXHIBIT 2**

**Thirty-Day Risk-Standardized Mortality Rates For Three Health Conditions, By Hospitals' Level Of Electronic Health Record (EHR) Adoption, 2008**




**SOURCE** Authors' analyses of data from the Hospital Quality Alliance (HQA) program; the American Hospital Association (AHA) annual survey; and the AHA Hospital IT Survey of Acute Care Hospitals in the U.S., 2008. **NOTES** All differences in risk-standardized mortality were nonsignificant. Estimates were obtained using multivariable models that adjusted for hospital characteristics. For definitions of *comprehensive* and *basic EHR adoption*, see Exhibit 1 Notes.

**EXHIBIT 3**

**Electronic Health Record (EHR) Adoption By Hospitals, And Length-Of-Stay, Readmissions, And Ratio Of Observed To Expected Costs, For All Causes And Three Medical Conditions, 2008**

| | All causes | AMI | CHF | Pneumonia |
|---|---|---|---|---|
| **RISK-ADJUSTED LENGTH-OF-STAY (DAYS) FOR HOSPITALS WITH:** | | | | |
| Comprehensive EHR adoption | 5.4 | 5.3 | 5.5 | 5.8 |
| Basic EHR adoption | 5.7 | 5.2 | 5.6 | 6.2 |
| No EHR adoption | 5.7 | 5.4 | 5.7 | 6.3 |
| *p* value | 0.03 | 0.33 | 0.18 | 0.003 |
| **RISK-ADJUSTED 30-DAY READMISSION RATES FOR HOSPITALS WITH:** | | | | |
| Comprehensive EHR adoption | 17.5 | 27.0 | 25.2 | 18.0 |
| Basic EHR adoption | 16.3 | 26.8 | 24.8 | 20.2 |
| No EHR adoption | 17.0 | 28.9 | 26.0 | 20.8 |
| *p* value | 0.41 | 0.32 | 0.36 | 0.20 |
| **RISK-ADJUSTED OBSERVED-TO-EXPECTED COST RATIO FOR HOSPITALS WITH:** | | | | |
| Comprehensive EHR adoption | 0.98 | 0.98 | 0.93 | 0.92 |
| Basic EHR adoption | 1.04 | 0.93 | 0.99 | 1.01 |
| No EHR adoption | 1.01 | 0.97 | 1.00 | 1.01 |
| *p* value | 0.22 | 0.27 | 0.17 | 0.08 |

**SOURCE** Authors' analyses of data from the Medicare Provider Analysis and Review File; Medicare Inpatient Impact File; American Hospital Association (AHA) annual survey; AHA Hospital IT Survey of Acute Care Hospitals in the U.S., 2008; and Area Resource File. **NOTES** Estimates were obtained using multivariable models that adjusted for hospital characteristics. AMI is acute myocardial infarction. CHF is congestive heart failure. For definitions of *comprehensive* and *basic EHR adoption*, see Exhibit 1 Notes.

We found no consistent associations between the adoption of individual functions and risk-standardized mortality rates. (For the underlying data, see the Technical Appendix.)[14]

**EFFICIENCY AND COST** We found no significant relationships between the adoption of the specific functions and our efficiency measures. For each of the three functions examined, hospitals with these functions had risk-adjusted lengths-of-stay, readmission rates, and cost ratios that

**EXHIBIT 4**

**Processes And Outcomes Of Care And Efficiency And Cost Metrics, By Hospitals' Adoption Of Specific Electronic Health Record (EHR) Functions, 2008**

| | Process and outcome summary scores, by health condition (%) | | | | Efficiency and cost | | |
|---|---|---|---|---|---|---|---|
| **Level of adoption of:** | **AMI** | **CHF** | **PN** | **SCIP** | **Risk-adjusted LOS (days)** | **Risk-adjusted readmission rate** | **Ratio of observed to expected costs** |
| **CLINICAL GUIDELINES** | | | | | | | |
| Comprehensive EHR | 96.5 | 90.5 | 93.1 | 92.7 | 5.7 | 16.9 | 1.02 |
| Basic EHR | 96.5 | 90.6 | 93.1 | 92.8 | 5.6 | 16.3 | 1.03 |
| No adoption | 96.1 | 88.4 | 92.2 | 91.7 | 5.7 | 17.0 | 1.01 |
| *p* value | 0.03 | <0.001 | <0.001 | <0.001 | 0.20 | 0.31 | 0.69 |
| **CLINICAL REMINDERS** | | | | | | | |
| Comprehensive EHR | 96.6 | 90.3 | 93.1 | 92.8 | 5.7 | 16.9 | 1.02 |
| Basic EHR | 96.6 | 89.7 | 92.9 | 92.6 | 5.6 | 16.4 | 1.03 |
| No adoption | 96.0 | 88.4 | 92.1 | 91.6 | 5.7 | 17.1 | 1.01 |
| *p* value | 0.03 | <0.001 | <0.001 | <0.001 | 0.28 | 0.30 | 0.21 |
| **COMPUTERIZED PRESCRIBING** | | | | | | | |
| Comprehensive EHR | 96.4 | 89.5 | 92.8 | 92.3 | 5.7 | 17.1 | 1.02 |
| Basic EHR | 95.8 | 88.1 | 92.1 | 92.4 | 5.6 | 16.1 | 1.02 |
| No adoption | 94.9 | 87.9 | 91.4 | 90.5 | 5.7 | 17.0 | 1.01 |
| *p* value | 0.07 | 0.09 | <0.001 | 0.01 | 0.52 | 0.09 | 0.49 |

**SOURCE** Authors' analyses of data from the Hospital Quality Alliance database; Medicare Provider Analysis and Review File; Medicare Inpatient Impact File, American Hospital Association (AHA) annual survey; AHA Hospital IT Survey of Acute Care Hospitals in the U.S., 2008; and Area Resource File. **NOTES** Estimates were obtained using multivariable models that adjusted for hospital characteristics. AMI is acute myocardial infarction. CHF is congestive heart failure. PN is pneumonia. SCIP is Surgical Care Improvement Project measures. LOS is length-of-stay. For definitions of *comprehensive* and *basic EHR adoption*, see Exhibit 1 Notes.

were comparable to those of hospitals without such systems (Exhibit 4).

## Discussion

The federal government has allocated an estimated $20 billion to spur the adoption of health IT. The rationale for this level of expenditure comes from an expectation that this technology will improve the quality and efficiency of health care delivery in the United States. We examined the relationship between electronic health record adoption among U.S. hospitals and key metrics of hospital quality and efficiency and found weak relationships. Across a large number of metrics examined, the relationships were modest at best and generally lacked statistical or clinical significance.

Given the investment that the private and public sectors have already made in the development and deployment of this technology, these are sobering findings. Yet they may also suggest that the benefits expected from electronic health record adoption will not accrue until a majority of providers use them and until there is sustained effort to create the infrastructure for exchange of data among physicians and hospitals. This will require organizational and process changes to achieve "meaningful use" of the technology.

Our study assesses the "effectiveness" of electronic health record systems as they are currently implemented across U.S. acute care hospitals. Similar to previous studies at pioneering institutions, we found some indications of benefit. On average, hospitals with electronic health records and especially systems with clinical decision support seem to have somewhat better performance on process measures. Obviously, these small differences by themselves, even if clinically meaningful, would not justify the investment.

At the same time, however, our findings may capture early signals of what functions are likely to have the most important impact on improving health care quality and efficiency. They stress the importance of further study to look beyond the adoption of technology to how it is being used. The careful examination of how health IT is used could provide critical information on how best to capitalize on their potential. Finally, these findings suggest that the proper way to think about health IT might not be as a short-term quick fix but, instead, as a long-term investment whose payoff will become clearer as its use matures.

**PREVIOUS RESEARCH** Prior studies have examined the potential impact of health IT on health care quality and costs. Richard Hillestad and colleagues modeled savings of more than $80 billion annually from widespread adoption of electronic health record systems, much of which came from reductions in lengths-of-stay.[22] Nearly identical savings were found by James Walker and colleagues, although mostly from robust health information exchange that reduced redundant tests and administrative burdens.[23] Recent reviews by others have found a paucity of empirical data on the potential cost impact of electronic health record adoption.[2,10] A recent study by David Himmelstein and colleagues examined technology use, quality, and administrative costs (as a portion of total costs) in a sample of U.S. hospitals and found no relationship.[24] Taken together, this work tells a consistent story and supports our conclusions.

**LIMITATIONS** There are limitations to our study that must be considered when interpreting our results. First, although we achieved a 63 percent response rate, nonresponding hospitals were somewhat different from responding hospitals. We attempted to compensate for this by adjusting for potential nonresponse bias, but such adjustments are not perfect.

Second, we focused on the availability of electronic health record systems, rather than on effective use. With policy makers' current focus on meaningful use, future work will need to move beyond implementation and examine how such systems are being deployed and effectively used. A third limitation, related to meaningful use, is our lack of data on electronic information exchange, or the ability of institutions to send useful data from one to another. It will be necessary to closely monitor the development of this infrastructure—a key component of meaningful use.

Additionally, we used cross-sectional data. Without a randomized trial, we cannot establish a causal relationship between electronic health records and hospital quality and efficiency. However, our findings provide strong evidence that any relationship between simply adopting electronic health records and gains in quality or costs of care are likely to be very small, if present at all. It is commonly believed that benefits from new technology may take as long as ten to fifteen years to accrue.[22,23] Although we were unable to determine how long electronic health record adopters had had systems in place, current adoption is still in its infancy, and optimal benefits may be years away.[11,22,23]

Our measures of cost and resource use have their own limitations: the risk-adjustment approach used administrative data, and the cost data came from hospital claims submitted to Medicare. Although these are the best available measures of inpatient costs, they might not adequately represent costs for those under age sixty-five. Further, they are imprecise, and they may have led us to miss small differences between adopters and nonadopters of electronic

health records.

Our analyses focused on a narrow set of quality measures, and it is possible that many of the benefits of electronic health records were in clinical areas we were not able to examine. Further, the lack of clinically meaningful differences on the quality measures may be due to "ceiling effects," as the overall scores were quite high. (A ceiling effect means that the effect of an intervention is underestimated because the scores can't distinguish between somewhat high and very high levels.) However, even among measures with room for improvement (such as surgical complication prevention) we did not see dramatic differences between adopters and nonadopters. Finally, we cannot completely discount the possibility that any significant findings, given the number of comparisons made, are due to chance alone.

**POLICY IMPLICATIONS** Our findings have direct implications for implementation of ARRA's "meaningful use" provisions. Specific ARRA provisions, as reflected in proposed regulations published in early 2010 by the U.S. Department of Health and Human Services (HHS), authorize significant, long-term Medicare and Medicaid financial incentives for physicians, hospitals, and other health care providers, to be followed, at least in the case of Medicare, by financial penalties.[4] Payment will hinge on providers' ability to demonstrate meaningful use of the technology. Under the law, this concept focuses on several basic attributes, including adoption of certified electronic health record systems, the ability to engage in electronic prescribing, the ability to exchange information, and the ability to report on clinical and other quality measures selected by the HHS secretary.

In our view, these findings underscore the appropriateness of the proposed rules, which manifest a dynamic and rigorous approach to defining *meaningful use*, with expectations rising over time as providers become accustomed to the technology. Specifically, the proposed rules state that *meaningful use* means a demonstrated ability to transmit information (such as electronic prescribing); use decision support; and generate information that is important to patients, health care practice, and public health.

The regulations also reflect an evolutionary approach to adoption and use by raising the bar over time through increasingly robust requirements, to better ensure steady progress toward advanced use skills. As such, HHS has chosen an appropriate strategy. This combines the reality of the current situation—that is, the fact that very few hospitals currently have the necessary functionalities in place to meet the interim meaningful-use criteria[25]—with a decisive policy push to move hospitals toward to effective utilization, so that the outcomes of adoption ultimately approach the promise of the technology.

Finally, our results have important implications for the regional entities that are being funded to support providers' adoption of electronic health records, known as Regional Extension Centers. Whether they will have the capability to affect the process changes that providers will need to realize quality and efficiency gains is unclear.

Our results suggest that without those process changes, providers are unlikely to obtain substantial gains in quality and efficiency. The lack of an evidence base behind how best to implement electronic health record systems to get the greatest gains in care surely makes this more challenging. Federal entities setting the research agenda need to pay greater attention to effective implementation of electronic health record systems to ensure that the large public and private investments are optimally used.

**CONCLUSION** We examined the relationship between the adoption of electronic health record systems and the quality and efficiency of care among a national sample of U.S. hospitals. We found a striking lack of relationship. Our findings suggest that if electronic health records are going to play an important role in promoting effective and efficient care, we will need to ensure that they are used in a way that drives the health care system toward these goals. ■

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14 The Technical Appendix can be accessed by clicking on the Technical Appendix link in the box to the right of the article online.

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**Catherine M. DesRoches**

Catherine M. DesRoches is a survey scientist and an assistant professor at the Institute for Health Policy, Massachusetts General Hospital, in Boston, Massachusetts. She has led or collaborated on international and national surveys about such topics as health information technology; the public's response to bioterrorism; insurance options for working adults; women's health issues; health insurance and access to care; attitudes toward alcohol, tobacco, and drugs; and Americans' health priorities. She has authored or coauthored more than forty original articles.

A graduate of Emmanuel College in Boston, DesRoches received her master of science degree from the University of Massachusetts School of Public Health and her doctoral degree in public health from the Mailman School of Public Health at Columbia University. Before assuming her current position in 2006, she spent six years at the Harvard School of Public Health. She also previously was a research associate at the Commonwealth Fund in New York City.

DesRoches first became interested in electronic health records as a research topic after President George W. Bush set the goal of near-universal adoption by 2014. Her professional goal over the next five years is to help move the research on electronic health record adoption "past implementation only to strategies for effective use that actually improve care," she says. For that to happen, however, the federal government is going to have to use sticks as well as carrots, "by mandating 'meaningful use' through payment incentives and real penalties," DesRoches says. The proposed rules on standards and meaningful use are an "excellent start, but we may need to see stiffer penalties to encourage the laggards."