

Evidence Of An Emerging Digital Divide Among Hospitals That Care For The Poor

A central policy question is whether health information technology investments prompted by the 2009 federal stimulus law will help close the gap.

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ABSTRACT: Some hospitals that disproportionately care for poor patients are falling behind in adopting electronic health records (EHRs). Data from a national survey indicate early evidence of an emerging digital divide: U.S. hospitals that provide care to large numbers of poor patients also had minimal use of EHRs. These same hospitals lagged others in quality performance as well, but those with EHR systems seemed to have eliminated the quality gap. These findings suggest that adopting EHRs should be a major policy goal of health reform measures targeting hospitals that serve large populations of poor patients. [Health Aff (Millwood). 2009;28(6):w1160-70 (published online 26 October 2009; 10.1377/hlthaff.28.6.w1160)]

IT IS WIDELY BELIEVED THAT HEALTH INFORMATION technology (IT) has the potential to improve the safety, efficiency, and effectiveness of care—propelling it to the center of ongoing health care reform discussions. The American Recovery and Reinvestment Act (ARRA) of 2009 (PL 111-5) authorized nearly \$30 billion to establish a national health IT infrastructure that uses financial incentives, through Medicare and Medicaid, to promote adoption of electronic health records (EHRs) by hospitals and physicians. ARRA (the so-called stimulus bill) requires the Office of the National Coordinator for Health Information Technology to ensure that rural communities, the uninsured, and medically under-

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served populations benefit from this technology. Although there is broad support for helping health care providers adopt EHRs, some worry that such efforts might exacerbate existing disparities in care by creating a new health care “digital divide” between providers that disproportionately care for the poor and those that do not.

There is reason to believe that if such a digital divide emerged, it would have deleterious effects on the provision of care. A central policy question becomes whether ARRA’s health IT policy reforms will be implemented in ways that reduce this risk. Prior research has shown that care for poor and minority patients is concentrated among a small number of providers.¹⁻⁴ Given the potential of EHRs to improve the efficiency and effectiveness of care, these providers’ ability to furnish high-quality health care may be further compromised if they lag in EHR adoption. Despite concerns among policymakers, there are few empirical data that assess whether such a gap exists. Previous studies documenting low EHR adoption among safety-net providers either lacked a comparison group or focused on small geographic areas or community health centers.⁵⁻⁸ We are unaware of any national data tracking EHR adoption among acute care providers that disproportionately care for poor patients. This paper is the first to use national data to address this issue.

In 2008, with support from the Office of the National Coordinator, we surveyed all acute care hospitals that were members of the American Hospital Association. We found that although a small number of U.S. hospitals had adopted comprehensive EHRs, a much larger proportion had adopted several key clinical functions that constitute an electronic record system.⁹ We used these national data to determine the following: (1) Are EHR adoption rates lower in hospitals that disproportionately care for poor patients? (2) Are rates of adoption of key underlying functions, such as clinical notes or computerized prescribing, lower in hospitals with a high proportion of poor patients? (3) Do such hospitals identify the same barriers to and facilitators of EHR adoption as other hospitals? (4) Is there evidence that EHR adoption might play an important role in reducing disparities in the quality of care provided by these hospitals?

Study Data And Methods

■ **Identifying hospitals that care for the poor.** There are no national data on the proportion of patients served by a given hospital who are poor. Therefore, we used a hospital’s Medicare disproportionate-share hospital (DSH) index as a surrogate measure.¹⁰ Each hospital is assigned an index by the Centers for Medicare and Medicaid Services (CMS) based on a combination of its fraction of elderly Medicare patients eligible for Supplemental Security Income (SSI) and its fraction of nonelderly patients with Medicaid coverage. The CMS uses this formula to identify hospitals eligible for additional Medicare payments for caring for the poor. We used the 2007 Impact File compiled by the CMS to obtain each organization’s DSH index.

We considered two alternative methods for specifying this variable. First, we examined the DSH index as a continuous variable. Second, we categorized all hospitals in the nation into quartiles by DSH index (hospitals in the top quartile were the 25 percent of U.S. hospitals with the highest DSH index score, and so on). These two approaches produced similar results.¹¹ High-DSH hospitals are those in the highest quartile of DSH index, and low-DSH hospitals are those in the lowest quartile.

We considered alternative methods for identifying hospitals that disproportionately care for the poor, including the proportion of inpatient days paid for by Medicaid. The DSH index has the advantage of capturing both the elderly poor (those eligible for SSI) and the nonelderly poor (Medicaid) and can be helpful in classifying the proportion of hospitals' patients who are poor when a large proportion of patients are elderly. The correlation between a hospital's ranking on the DSH index and its proportion of Medicaid patients was 0.68 and was highly statistically significant.

■ **Hospital IT survey.** We partnered with the American Hospital Association to administer the hospital IT survey to all acute care member hospitals in 2008 as a supplement in the association's annual survey. The details of its development and administration are described elsewhere.⁹ Briefly, working with a federally convened national expert panel, we developed a new survey. The survey was sent to each hospital's chief executive officer, who was asked to assign the most knowledgeable person in the institution (generally the chief information officer or equivalent) to complete it. The survey achieved a response rate of 63.1 percent.

Each hospital reported on the presence of thirty-two electronic clinical functions and whether they were fully implemented in all major clinical units, implemented in one or more (but not all) major clinical units, or not yet fully implemented in any unit of the hospital. The expert panel defined a *comprehensive EHR* as twenty-four clinical functions implemented across all major clinical units and a *basic EHR* as ten clinical functions implemented in at least one major clinical unit.¹²

■ **Quality of care.** To examine performance on quality metrics, we used data from the 1 September 2008 public release of data from the Hospital Quality Alliance program, which reports performance scores for nearly all acute care hospitals based on patients seen during calendar year 2007. We used the Hospital Quality Alliance process measures to calculate individual hospitals' summary performance scores for four conditions: acute myocardial infarction (eight process measures), congestive heart failure (four measures), pneumonia (seven measures), and surgical complication prevention (five measures).¹³ We used a widely deployed approach to create condition-specific summary scores.¹⁴

■ **Analysis.** We used data from the American Hospital Association annual survey to examine differences in hospital characteristics among hospitals based on the proportion of poor patients (across the four quartiles of DSH index). We used one-way analyses of variance and chi-square tests as appropriate.

Next, we examined rates of adoption of basic and comprehensive EHRs across the four DSH-index quartiles. Because the adoption rates of comprehensive EHRs were so low across all hospitals,⁹ we combined basic and comprehensive EHRs. We built multivariable models with level of EHR adoption as the outcome and DSH index as the primary predictor, adjusting for key hospital characteristics, including size, teaching status, region, profit status, and location (urban versus rural).

We examined whether the adoption of specific clinical functions that constitute an EHR differed by the proportion of poor patients in the hospital. These analyses were motivated by two factors. First, we hypothesized that the overall low levels of EHR adoption would likely limit our power to find differences. Second, understanding differences in the adoption of specific functions is essential to developing effective policies aimed at optimizing health IT capacity in the future. We used a similar analytical approach to the one described earlier: the adoption of the specific function (such as electronic physician notes) was the dependent variable, and the DSH index was the primary independent variable, with the hospital characteristics described as covariates. We examined all twenty-four functions that constitute a comprehensive EHR.

Next, we examined whether barriers to and facilitators of EHR adoption varied across hospitals based on the proportion of poor patients served by each institution. We identified the five barriers and facilitators most frequently cited among all respondents and examined whether they were cited more or less often by hospitals that disproportionately care for the poor. We built logistic regression models (adjusting for the hospital characteristics mentioned above) to assess whether the proportion of poor patients was associated with respondents' reports of specific barriers and facilitators.

Finally, we were interested in whether adoption of EHR systems would affect the quality of care for providers with a high proportion of poor patients. We first examined whether a high DSH index was associated with lower quality scores. We then stratified these results by adopters and nonadopters of EHR systems and tested for effect modification (which examines whether the relationship between two variables [in this case, DSH index and quality of care] is affected by the presence of a third variable [in this case, EHRs]). This allowed us to determine whether the relationship between the proportion of poor patients served by a hospital and the quality of care provided varied by EHR status. All analyses were conducted using SAS 9.0.

Study Results

Of the 3,747 acute care nonfederal U.S. hospitals with available DSH-index scores, we received responses from 2,368, for a response rate of 63.1 percent. We looked across the four DSH index quartiles and found that all had comparable response rates (Exhibit 1). When we examined characteristics of hospitals based on

EXHIBIT 1
Hospital Characteristics, By Disproportionate-Share Hospital (DSH) Index Quartile, Among Responders To The Health Information Technology Survey

Characteristic	DSH quartile				p value
	1 (highest)	2	3	4 (lowest)	
Patient population (mean)					
Proportion of Medicare patients	40%	47%	49%	53%	<0.001
Proportion of Medicaid patients	27	19	15	9	<0.001
Proportion of black patients	18	7	5	4	<0.001
Proportion of Hispanic patients	4	1	1	1	<0.001
Structural characteristics (mean)					
Hospital size (number of beds)					
Small (0-99)	29	30	36	39	<0.001
Medium (100-399)	51	59	54	55	
Large (400+)	20	11	9	5	
Teaching hospital	15	7	5	3	<0.001
Geographic region					
Northeast	10	15	17	22	<0.001
Midwest	9	9	37	38	
South	56	50	32	26	
West	25	18	14	14	
Profit status					
For-profit	24	17	12	14	<0.001
Private nonprofit	50	62	71	74	
Public	26	21	18	12	
Urban location	83	83	81	83	0.66

SOURCE: Authors' analysis of their survey data.

DSH index quartile, we found that compared to low-DSH hospitals, high-DSH hospitals cared for a much higher proportion of Medicaid patients, elderly black patients, and elderly Hispanic patients, and a substantially lower proportion of Medicare patients (Exhibit 1). High-DSH hospitals were also more often large and major teaching hospitals. Finally, compared to low-DSH hospitals, high-DSH hospitals were more often located in the South and more often for-profit.

■ **Adoption of clinical functions in electronic format.** We found several small but consistent differences in implementation of key clinical functions between U.S. hospitals with a high DSH index and those with a low DSH index (Exhibit 2). These were primarily concentrated in the areas of electronic clinical documentation and viewing of results. Among the twenty-four functions examined, high-DSH hospitals had lower rates of adoption of all twenty-four compared to low-DSH hospitals, although the magnitude of the gap varied greatly and not all differences were statistically significant. Statistically significant differences included lower rates of electronic medication lists and electronic discharge summaries. For key functions for which overall adoption levels were low, such as computerized physician medication order entry, the differences in adoption were smaller and not significant (Exhibit 2). When examining DSH index as a continuous variable, we found a similar pattern,

EXHIBIT 2
Selected Electronic Health Record (EHR) Functionalities And Their Level Of Implementation In DSH-Index Responders

Clinical functionality	Disproportionate-share hospital (DSH) quartile				p value
	1 (highest)	2	3	4 (lowest)	
Electronic clinical documentation					
Demographic characteristics	87%	88%	88%	92%	0.045
Medication lists	62	66	71	74	<0.001
Nursing assessments	57	64	67	67	0.003
Physician notes	26	27	31	33	0.03
Problem lists	41	50	52	51	0.001
Discharge summaries	60	64	72	69	0.001
Advanced directives	40	51	54	53	<0.001
Results viewing					
Diagnostic test images (EKG tracing)	44	53	58	57	<0.001
Diagnostic test results (echo report)	63	69	70	71	0.02
Lab reports	87	91	92	90	0.04
Radiology images	77	87	85	85	<0.001
Radiology reports	89	91	91	90	0.55
Consultant reports	59	64	69	68	0.009
Computerized provider order entry					
Laboratory tests	32	29	32	35	0.20
Radiologic tests	33	30	32	35	0.37
Medications	29	26	29	32	0.27
Consultation requests	25	24	26	27	0.73
Nursing orders	32	30	33	33	0.71
Decision support					
Clinical guidelines (beta-blockers post-MI)	27	29	32	30	0.47
Clinical reminders (Pneumovax)	35	40	37	40	0.17
Drug allergy alerts	63	67	71	69	0.11
Drug-drug interaction alerts	63	68	70	70	0.09
Drug-lab interaction alerts	49	57	57	54	0.05
Drug dosing support (renal dose guidance)	46	52	54	52	0.07
Bar coding					
Medication administration	27	38	37	41	<0.001
EHR					
Comprehensive EHR	1.5	1.5	1.7	2.5	0.33
Basic EHR	8.2	7.9	8.4	9.0	0.84
Comprehensive or basic	9.7	9.4	10.1	11.5	0.43

SOURCE: Authors' analysis of their survey data.

NOTES: For explanation of basic versus comprehensive EHRs, see text. MI is myocardial infarction.

although a higher DSH index was now associated with a lower level of adoption of clinical decision-support tools.¹⁵

When we examined the rates of adoption of a basic EHR (ten clinical functions implemented in at least one clinical unit) or a comprehensive EHR (twenty-four clinical functions implemented in all major clinical units), we found that the dif-

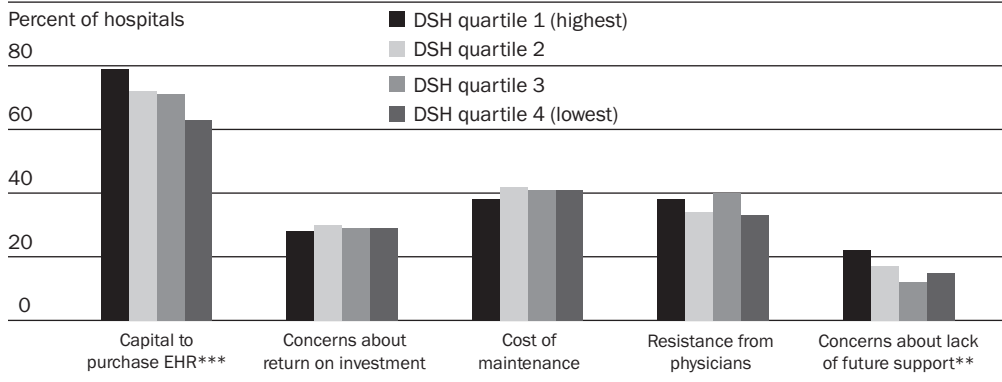
ferences between high- and low-DSH-index hospitals were small and nonsignificant. High-DSH-index hospitals had slightly lower rates of adoption of either the basic or comprehensive EHR compared to low-DSH-index hospitals (Exhibit 2). We obtained similar results using the DSH index as a continuous variable.

■ **Barriers to and facilitators of EHR adoption.** Among hospitals without an EHR system, inadequate capital was cited significantly more often as a major barrier to adoption by high-DSH hospitals (77 percent) than low-DSH hospitals (63 percent; Exhibit 3). High- and low-DSH hospitals reported concerns about the other four main barriers at comparable rates. High-DSH hospitals were significantly more likely (21 percent) than low-DSH hospitals (16 percent) to report concerns about future support. Most hospitals identified financial considerations as likely to have a major positive impact on EHR adoption. There were no differences in facilitators identified by high- and low-DSH hospitals (data not shown).

■ **Potential impact of health IT adoption on quality.** We assessed whether the proportion of poor patients in a given hospital was related to the quality of care provided. We found a highly statistically significant association in all four conditions examined: a 10 percent increase in DSH index was associated with a 0.5 percent lower performance on acute myocardial infarction quality metrics, 1.0 percent lower performance on congestive heart failure metrics, 0.9 percent lower performance on pneumonia metrics, and 1.5 percent lower performance on surgical complication prevention metrics.¹⁶

Differences in quality performance among hospitals using EHRs versus those not using EHRs demonstrated a consistent pattern. Among hospitals with an EHR (basic or comprehensive), the DSH index was not negatively associated with quality performance.¹⁶ Among non-EHR adopters, however, a higher DSH index was associated with lower quality performance for three of the four conditions ex-

EXHIBIT 3
Major Barriers To Health Information Technology (IT) Adoption Among Disproportionate-Share Hospitals With No Electronic Health Record (EHR)



SOURCE: Authors' analysis of their survey data.
 ** $p < 0.05$ *** $p < 0.01$

amined. The test for interaction, which examines whether the relationship between DSH index and quality score varies by EHR status, was statistically significant for three of the four conditions examined.¹⁶

Discussion

As the nation moves toward greater use of EHRs, it is important to determine whether or not there are gaps in adoption rates between hospitals that disproportionately care for the poor and those that do not. We found that although overall EHR adoption rates were quite low, many of the individual EHR functions were adopted less often by hospitals that serve a high proportion of poor patients. These hospitals more often cited fiscal concerns as a major barrier to EHR adoption. Finally, there seem to be modest differences in quality of care between hospitals that disproportionately care for the poor and those that do not. Our findings suggest that EHRs may help mitigate these disparities.

As policymakers struggle with ways to improve the efficiency and effectiveness of the health care system, they have focused on health IT as a key part of the solution. There is ample evidence that specific EHR functions, when effectively implemented, improve the quality of care delivered.^{17,18} EHRs, especially systems that interact with each other and with other systems, can lead to greater efficiencies, reduced costs, and substantial savings as well.¹⁹⁻²² The promise of better quality at lower cost was a major driver for focusing on health IT in the stimulus bill.

The bill's financial incentive provisions for Medicare and Medicaid health IT adoption hold important implications for high-DSH hospitals. Although the Medicare provisions are important for all hospitals, high-DSH facilities have fewer Medicare patients and thus will depend on the Medicaid incentives, which are available to hospitals with sizable Medicaid inpatient populations. Unlike the Medicare incentives, which will reward "meaningful use" of EHR systems, Medicaid incentives can also finance start-up and adoption costs and thus can help offset limited access to investment capital.²³

Whether or not ARRA will spur health IT adoption at high-DSH hospitals is unclear. Implementation of the Medicaid health IT provision is not a mandatory condition of state Medicaid participation. Although provider payments are 100 percent federally financed, states must pay a modest proportion of the administrative costs associated with adoption of EHRs. If cash-strapped state Medicaid programs opt out, high-DSH hospitals will likely fall further behind in adoption. With a 2011 effective date for the health IT reforms, federal guidance and technical assistance become crucial.

To qualify for financial incentives under ARRA, hospitals and providers will need to demonstrate "meaningful use" of EHR systems. How Medicare and state Medicaid programs define "meaningful use" will obviously be centrally important. Medicare incentives will be tied to the federal definition that is currently in development, but state Medicaid programs are permitted to create their own.

Whether or not states will adhere to federal policy is also unknown. Given this additional set of challenges, tracking implementation of ARRA's financial incentives in a high-DSH-hospital context will be important.

We found that differences in quality between high- and low-DSH hospitals were essentially erased among EHR adopters. This provides more evidence that ensuring adequate takeup of this technology among high-DSH hospitals is important. Although it is tempting to conclude that EHRs helped "equalize" quality performance between high- and low-DSH hospitals, we cannot be sure. Other studies indicate that the impact of EHR adoption may be driven by how effectively EHR systems are implemented into clinical practice.^{24, 25} Therefore, tracking will need to focus not just on adoption but also on the impact these systems have on the efficiency and effectiveness of the care delivered.

Others have also examined the adoption and use of EHRs among providers who disproportionately care for the poor,⁵⁻⁸ although none in the hospital setting. Alexandra Shields found relatively low rates of EHR adoption among federally qualified community health centers,⁶ but their numbers were not much different from those in the private sector.²⁶ Esther Hing and Catherine Burt, using data from the 2005 and 2006 National Ambulatory Medical Care Surveys, found that racial and ethnic minorities, as well as those with Medicaid, were less likely to see a provider who used an EHR compared to privately insured white patients.⁷ Ashish Jha and colleagues found no such gap in a statewide study of physicians in Massachusetts,²⁷ although the rate of EHR adoption in Massachusetts is higher than the national average, and minorities were far more likely to receive care at academic medical centers.^{27, 28}

■ **Study limitations.** There are limitations to our study. First, we did not examine how EHR systems are used within hospitals. Given that high-DSH hospitals may have fewer capabilities to use these systems effectively than low-DSH hospitals, we may be underestimating the clinical impact of identified gaps in adoption. Second, we were unable to identify why there were marked differences in the adoption of certain functions but not others. The financial challenges faced by high-DSH hospitals may make adoption of certain systems, such as electronic documentation (which can be cumbersome and expensive), particularly difficult. However, some of these expensive functions, such as electronic discharge summaries, are particularly important when caring for an underserved population that may often encounter uncoordinated care.

Further, we were able to assess only those hospitals that are members of the American Hospital Association and that reported their DSH index to the CMS. Hospitals that we were not able to examine included small critical-access hospitals that care for a small proportion of the rural public, federal institutions such as those run by the Departments of Veterans Affairs or Defense, nonacute hospitals, specialty hospitals, children's hospitals, and psychiatric institutions. Thus, although we missed a modest number of institutions, our study did capture those

hospitals that provide the large majority of acute medical and surgical care to the American public.

Another limitation is that we did not have a direct measure of the number of poor patients in any given hospital. The Medicare DSH index, although the standard metric employed by the federal government, is inexact. Others have used proportion of Medicaid as the metric to assess the number of poor patients in a hospital. This, too, has important limitations, including not capturing the elderly poor.

Our measure of what constitutes an EHR was novel and has not been used before. The definition was created by an expert panel as part of a federally funded effort to define and measure EHRs. Although it has not been used widely until now, we expect that it will be the metric used by the Office of the National Coordinator to measure EHR adoption among U.S. hospitals going forward.

Finally, although we achieved a high response rate, nonresponders may have been systematically different from responders, potentially biasing our results. We used statistical approaches to correct for nonresponse bias, but such efforts are imperfect.

■ Concluding comments. In summary, we examined the adoption of EHR systems and their key components by hospitals that disproportionately care for the poor and those that do not. We found for many of the functions examined, hospitals that served a higher proportion of poor patients had modestly lower levels of adoption of health IT. Further, our results suggest that EHR systems may be helpful in reducing the disparities in care between high- and low-DSH hospitals. While the Obama administration and Congress seek to craft effective policies to stimulate the adoption and use of health IT, it will be critical to ensure that institutions that care for the most vulnerable Americans are not left behind.

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NOTES

1. Smedley BD, Stith AY, Nelson AR, editors. Unequal treatment: confronting racial and ethnic disparities in health care. Washington (DC): National Academies Press; 2002.
2. Bach PB, Pham HH, Schrag D, Tate RC, Hargraves JL. Primary care physicians who treat blacks and whites. *N Engl J Med*. 2004;351(6):575–84.
3. Jha AK, Orav EJ, Li Z, Epstein AM. Concentration and quality of hospitals that care for elderly black patients. *Arch Intern Med*. 2007;167(11):1177–82.
4. Jha AK, Orav EJ, Zheng J, Epstein AM. The characteristics and performance of hospitals that care for elderly Hispanic Americans. *Health Aff (Millwood)*. 2008;27(2):528–37.
5. Jha AK, Ferris TG, Donelan K, DesRoches C, Shields A, Rosenbaum S, et al. How common are electronic health records in the United States? A summary of the evidence. *Health Aff (Millwood)*. 2006;25(6):w496–507.
6. Shields AE, Shin P, Leu MG, Levy DE, Betancourt RM, Hawkins D, et al. Adoption of health information technology in community health centers: results of a national survey. *Health Aff (Millwood)*. 2007;26

- (5):1373–83.
7. Hing E, Burt CW. Are there patient disparities when electronic health records are adopted? *J Health Care Poor Underserved*. 2009;20(2):473–88.
 8. Miller RH, West CE. The value of electronic health records in community health centers: policy implications. *Health Aff (Millwood)*. 2007;26(1):206–14.
 9. Jha AK, DesRoches CM, Campbell EG, Donelan K, Rao SR, Ferris TG, et al. Use of electronic health records in U.S. hospitals. *N Engl J Med*. 2009;360(16):1628–38.
 10. Centers for Medicare and Medicaid Services. Disproportionate share hospital (DSH) [Internet]. Baltimore (MD): CMS; 2009 Jun 24 [cited 2009 Aug 24]. Available from: http://www.cms.hhs.gov/acuteinpatientpps/05_dsh.asp
 11. We show data based on quartiles in the main results, and we display results using the DSH index as a continuous variable in Appendix Exhibits 1 and 2, online at <http://content.healthaffairs.org/cgi/content/full/hlthaff.28.6.w1160/DC2>.
 12. Functions required for comprehensive and basic systems are in Appendix Exhibit 3, online as in Note 11.
 13. Specific indicators are listed in Appendix Exhibit 4, online as in Note 11.
 14. Jha AK, Orav EJ, Dobson A, Book RA, Epstein AM. Measuring efficiency: the association of hospital costs and quality of care. *Health Aff (Millwood)*. 2009;28(3):897–906.
 15. See Appendix Exhibit 5, online as in Note 11.
 16. See Appendix Exhibit 5, online as in Note 11.
 17. Chaudhry B, Wang J, Wu S, Maglione M, Mojica W, Roth E, et al. Systematic review: impact of health information technology on quality, efficiency, and costs of medical care. *Ann Intern Med*. 2006;144(10):742–52.
 18. Goldzweig CL, Towfigh A, Maglione M, Shekelle PG. Costs and benefits of health information technology: new trends from the literature. *Health Aff (Millwood)*. 2009;28(2):w282–93.
 19. Hillestad R, Bigelow J, Bower A, Girosi F, Meili R, Scoville R, et al. Can electronic medical record systems transform health care? Potential health benefits, savings, and costs. *Health Aff (Millwood)*. 2005;24(5):1103–17.
 20. Bu D, Pan E, Walker J, Adler-Milstein J, Kendrick D, Hook JM, et al. Benefits of information technology-enabled diabetes management. *Diabetes Care*. 2007;30(5):1137–42.
 21. Kuperman GJ, Gibson RF. Computer physician order entry: benefits, costs, and issues. *Ann Intern Med*. 2003;139(1):31–9.
 22. Shekelle PG, Morton SC, Keeler EB. Costs and benefits of health information technology. *Health Aff (Millwood)*. 2006;28(2):w282–93.
 23. National Governors Association. State opportunities under the American Recovery and Reinvestment Act: health information technology (Title XIII) [Internet]. Washington (DC): NGA; 2009 Feb 25 [cited 2009 Sep 24]. Available from: <http://www.nga.org/Files/pdf/ARRAHEALTHIT.PDF>
 24. Linder JA, Ma J, Bates DW, Middleton B, Stafford RS. Electronic health record use and the quality of ambulatory care in the United States. *Arch Intern Med*. 2007;167(13):1400–5.
 25. Zhou L, Soran CS, Jenter CA, Volk LA, Orav EJ, Bates DW, et al. The relationship between electronic health record use and quality of care over time. *J Am Med Inform Assoc*. 2009;16(4):457–64.
 26. DesRoches CM, Campbell EG, Rao SR, Donelan K, Ferris TG, Jha A, et al. Electronic health records in ambulatory care—a national survey of physicians. *N Engl J Med*. 2008;359(1):50–60.
 27. Jha AK, Bates DW, Jenter C, Orav EJ, Zheng J, Cleary P, et al. Electronic health records: use, barriers, and satisfaction among physicians who care for black and Hispanic patients. *J Eval Clin Pract*. 2009;15(1):158–63.
 28. Simon SR, Kaushal R, Cleary PD, Jenter CA, Volk LA, Poon EG, et al. Correlates of electronic health record adoption in office practices: a statewide survey. *J Am Med Inform Assoc*. 2007;14(1):110–7.