
MARKET WATCH

Adoption Of Health Information Technology In Community Health Centers: Results Of A National Survey

Investing in health centers' health IT capacity is a valuable strategy for reducing health disparities.

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ABSTRACT: To the extent that health information technology (IT) improves health care quality, differential adoption among providers that serve vulnerable populations may exacerbate health disparities. This first national survey of federally funded community health centers (CHCs) shows that although 26 percent reported some electronic health record (EHR) capacity and 13 percent have the minimal set of EHR functionalities, CHCs serving the most poor and uninsured patients were less likely to have a functional EHR. CHCs cited lack of capital as the top barrier to adoption. Ensuring comparable health IT capacity among providers that disproportionately serve disadvantaged patients will have increasing relevance for disparities; thus, monitoring adoption among such providers should be a priority. [*Health Affairs* 26, no. 5 (2007): 1373–1383; 10.1377/hlthaff.26.5.1373]

ESTIMATES OF health information technology (IT) adoption differ as a result of variable definitions, sampling techniques, and data quality; however, the broad consensus is that health IT—and electronic health records (EHRs) in particular—can greatly improve health care quality, safety, and efficiency.¹ The potential to reduce health disparities also has been frequently noted.²

At least one recent study has documented significant quality improvements achieved by community health centers (CHCs) through the use of electronic patient registries.³ New federal initiatives have also emphasized the critical role of health IT in realizing the future potential of genomic medicine to improve clinical care.⁴ Recent analyses report adoption rates ranging from 9 percent to 24 percent, de-

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pending on the level of functionality achieved, and a recent environmental scan placed the best estimate of EHR adoption among physicians at 17 percent in 2004.⁵

Enhanced health IT capacity—and EHRs in particular—may indeed provide new leverage points for addressing health disparities, but this will occur only if patients from traditionally underserved groups have access to the clinical benefits associated with health IT. Conversely, slower adoption of health IT-enhanced health care among providers of care to historically underserved populations could exacerbate existing health disparities.⁶

■ **CHCs' patient population.** CHCs are important safety-net providers.⁷ For more than forty years, they have provided medical, dental, and behavioral health care for low-income people, uninsured people, migrant farmers, the homeless, and others in need of medical assistance.⁸ Nearly two-thirds of CHC patients are racial or ethnic minorities, and 30 percent are not fluent in English.⁹ Nationally, CHCs serve more than sixteen million patients, including one in four people with family incomes at or below the federal poverty level, one in seven who are uninsured, one in nine Medicaid beneficiaries, one in ten minorities, and one in nine rural residents.¹⁰

CHCs' mission is reflected in their disadvantageous payer mix and poor revenue streams. Three-quarters of their patients are uninsured or covered by Medicaid, and their current average operating margin is less than 1 percent, leaving them poorly equipped to make substantial capital investments.¹¹ Since 1999, the number of patients served by CHCs has increased more than 50 percent.¹²

■ **CHCs and health IT.** Data on health IT adoption among CHCs are limited. The Community Clinics Initiative (CCI) has conducted four assessments of health IT capacity—including EHRs, patient registries, practice management systems, networks and connectivity, hardware, software, and staffing—among California health centers and clinics since 2000. Although these reports are not peer-reviewed, results show a growth in the number of health centers and clinics that have

or are planning to implement an EHR from 12 percent in 2000 to more than 50 percent in 2006.¹³ A 2005 qualitative study of seven health center networks identified as being CHC leaders emphasized the role of networks in facilitating access to health IT, as well as the importance of understanding the relationship between clinical and administrative health IT applications and involving clinicians in all phases of EHR implementation.¹⁴ These initial efforts provide insights into challenges faced by CHCs in developing health IT capacity; however, no national study has addressed CHCs' health IT adoption rates. This study provides the first national assessment of current health IT capacity and EHR adoption rates among this important group of safety-net providers and identifies key barriers to EHR adoption.

Study Data And Methods

■ **Data.** This survey was conducted among the universe of health centers that were federally funded as of July 2005 and reported data to the Bureau of Primary Health Care's (BPHC's) Uniform Data System (UDS) in 2004 (N = 914). Because one of our goals was to assess the rate of health IT adoption among CHCs relative to primary care physicians, we used existing, well-tested items from the 2006 National Ambulatory Medical Care Survey (NAMCS) survey instrument to assess rates of EHR adoption, capacity with respect to specific functionalities, and use of electronic billing.¹⁵ Survey items addressing barriers to health IT adoption were adapted from the Medical Group Management Association (MGMA) Center for Research survey of health IT, and health IT staffing patterns were adapted from the CCI survey instruments.¹⁶ Additional items were developed de novo with input from health center directors serving on the HIT Adoption Working Group of the National Association of Community Health Centers (NACHC). The draft survey instrument was reviewed by representatives from the Agency for Healthcare Research and Quality (AHRQ) and the Health Resources and Services Administration (HRSA), as well as by

experts in the field.

Data collection was conducted over a three-month period, from March to May 2006. Surveys were completed by the executive directors of the CHCs or designated staff (most often the medical director or dedicated IT personnel). Surveys were mailed and e-mailed to all CHC directors. Follow-up e-mail reminders and telephone calls were made, and respondents were given the option of completing the survey on paper or electronically. For CHCs with multiple sites, respondents were asked to report the status of health IT adoption for their primary site.¹⁷ Data from the returned surveys were double-entered, checked for systematic errors during routine data cleaning, and linked by unique provider identification number to the 2004 UDS data file. This protocol was approved by the institutional review board of the Massachusetts General Hospital (MGH).

■ **Measures of health IT adoption.** We included two measures of health IT adoption in our analysis. The first measure, drawn from the 2006 NAMCS questionnaire, asked respondents, “Does your health center use electronic medical records (not including billing records)?” with available responses of “yes, all electronic”; “yes, part paper and part electronic”; “no”; and “don’t know.”¹⁸ Respondents reporting a full or partial EHR were further asked to describe the specific functionalities of their EHR system.

Our second measure, which is the primary dependent variable for this analysis, was constructed from the 2006 NAMCS item reporting specific health IT functionalities. Following the recommendations of the Expert Consensus Panel of the HIT Adoption Initiative of the Office of the National Coordinator for HIT, we defined the minimal set of functionalities deemed to constitute a “functional EHR” in 2006 as including patient demographics, computerized orders for prescriptions, computerized orders for tests and lab results, and clinical notes.¹⁹ We also included several measures of other health IT capacities, including maintenance of disease-specific registries, patient registries funded

through HRSA’s Health Disparities Collaboratives, having a dedicated IT staff person, and plans for installing a new EHR system or replacing an existing system within the next three years.

■ **CHC characteristics included in the analysis.** In logistic regression analysis using “functional EHR” as the dependent variable, we included several additional CHC characteristics derived from the 2004 UDS data file as control variables. Geographical information included urban or rural location and census region. Health center size was characterized by number of patients served and number of health care delivery sites operating under federal health center grants. Health centers’ financial characteristics included the ratio of their revenues to costs, patients’ insurance status (privately insured, Medicaid, Medicare, and uninsured), and the proportion of patients enrolled in managed care. Health center grantees were further characterized by federal funding status as CHC grantees, homeless centers, migrant health centers, school-based clinics, and other types.

Health center personnel characteristics included the number of full-time-equivalent (FTE) physicians in family practice, general medicine, internal medicine, obstetrics/gynecology, or pediatrics; nurse practitioners, physician assistants, and certified nurse midwives; and laboratory or radiology technicians. Characteristics of the patient populations served by CHCs included patients’ self-identified race/ethnicity, family income, and age distribution. Assessment of family income was available for 74 percent of CHC patients nationally. There was no association between percentage of patients for whom family income was unknown and a health center’s EHR adoption status. Variables indicating the proportion of patients below poverty served by CHCs were based on all patients for whom family income was known.

■ **Final sample.** Our final sample excluded fifty-five health centers that received only migrant, homeless, school-based, or public housing grants and no federal CHC funding through the Section 330 grant program. Thus,

the regression model includes a final sample of 672 health centers. Logistic regression analysis comparing respondents to nonrespondents on all variables included in our final model were conducted using the full UDS 2004 data file and gave us no evidence of response bias. Except as noted above, there were no missing data for items used in this analysis. All analyses were conducted using Intercooled Stata 9.2.²⁰

Study Results

■ **Characteristics of respondent CHCs.** The final study population included 725 CHCs, reflecting a response rate of 79.5 percent. The majority of these CHCs served more than 10,000 unique patients in 2004. On average, 72 percent of CHC patients were either uninsured or on Medicaid (Exhibit 1). Only 17 percent were privately insured, and only 7 percent were Medicare patients. Approximately 17 percent of CHC patients were enrolled in managed care, and, on average, more than half of CHCs nationally have a revenue-to-cost ratio less than 1. More than half of all CHC patients have family incomes below the federal poverty level; approximately 60 percent are from racial/ethnic minority communities.

■ **Health IT capacity among CHCs.** Nationally, almost nine-tenths of CHCs maintain at least one disease-specific registry, four-fifths maintain patient registries as part of HRSA's Health Disparities Collaboratives, three-fifths have a dedicated IT staff person, and three-fifths report having plans to install a new EHR system or replace an existing EHR system within the next three years (Exhibit 1).²¹ Approximately one-fourth of CHCs report having at least some EHR capacity. Among those that have a full or partial EHR, virtually all have patient demographics electronically, 85 percent have computerized orders for prescriptions, 83 percent have electronic clinical notes, 71 percent have computerized orders for tests, and 71 percent have computerized lab results (Exhibit 1).

Although one-fourth of CHCs reported having either full or partial EHR, only 13 percent have the minimum set of functionalities defined by the national HIT Adoption Initiative (Exhibit 2). Less than two-thirds of those who reported that they have a full EHR and only about half of those reporting that they had a partial EHR met these minimal criteria.

■ **Factors associated with having a functional EHR.** In the bivariate analyses of health center location, size, financial characteristics, and patient mix, factors significantly associated with having a functional EHR included the number of patients served ($p = 0.012$), number of FTE providers ($p = 0.02$), and having a disproportionate share of Latino patients ($p = 0.025$).

“Patient-mix characteristics emerged as the primary driver of EHR adoption.”

In multivariate analyses, patient-mix characteristics emerged as the primary driver of EHR adoption. Controlling for location (region, urban/rural location), size (number of unique patients served, number of sites), medical personnel (number of physician, mid-level, and technical staff per patient), payer mix (proportion of patients who are privately insured, Medicaid, Medicare, or uninsured), percentage of patients enrolled in managed care, revenue-to-cost ratio, and patient demographic characteristics (age, race/ethnicity, family income), CHCs serving a disproportionate number of uninsured patients or patients with family incomes below the poverty level were significantly less likely ($p = 0.01$) to have a functional EHR (Exhibit 3). Specifically, health centers serving a greater proportion of uninsured patients (above the median) had only 47 percent the odds of having a functional EHR compared to centers whose uninsured patient distribution was below the median. Centers ranking above the median in proportion of patients with family incomes below the federal poverty level had only a 44 percent odds of having a functional EHR compared to those serving fewer patients in poverty (Exhibit 3).

■ **Barriers to health IT adoption.** To

EXHIBIT 1
Characteristics Of Community Health Center Sample, 2004

Health center characteristics	Distribution of characteristics (%)
Geographic region	
Northeast	20
Midwest	18
West	28
South	34
Revenue-to-cost ratio	
0.0-0.8	9
0.8-1.0	49
>1.0	42
Patient distribution by payer	
Private insurance	17
Medicaid	31
Medicare	7
Uninsured	41
Other	4
Patient characteristics	
Family income	
Below federal poverty level	52
100%-200% of federal poverty level	16
More than 200% of federal poverty level	7
Unknown	26
Race and ethnicity	
White	43
Black	21
Asian	3
Native American	2
Latino	25
Unknown	6
Health IT characteristics	
Self-reported EHR adoption	
No EHR	75
Full EHR	9
Partial EHR (part paper and part electronic)	16
EHR functionalities	
Electronic patient demographics	24
Computerized orders for prescriptions	21
Computerized orders for tests	17
Electronic lab results	18
Electronic clinical notes	20
Maintains one or more disease-specific registries	86
Maintains patient registries as part of HRSA's Health Disparities Collaboratives	80
Has dedicated health IT staff person	59
Has plans for installing new EHR or replacing system within three years	60

SOURCE: Derived from the authors' analyses.

NOTES: IT is information technology. EHR is electronic health record. HRSA is Health Resources and Services Administration.

better understand the primary barriers to health IT adoption among CHCs, we asked those 633 CHCs that did not have a functional EHR to rate the importance of several potential barriers (Exhibit 4). Nine-tenths of re-

spondents noted the lack of capital to invest in EHRs as an important or very important barrier to adoption, four-fifths cited the inability to integrate the EHR with the center's current billing or claims submission system, and three-

EXHIBIT 2 Self-Reported Electronic Health Record (EHR) Versus Functional EHR In Community Health Centers, 2004

Self-reported EHR adoption	Total reporting		Percent meeting criteria for functional EHR
	Number	Percent	
Total	725	100	13
Full EHR	62	9	60
Partial EHR	115	16	47
None	545	75	0
Don't know	3	0	0

SOURCE: Derived from the authors' analyses.

NOTES: Minimum criteria deemed to constitute an EHR include electronic patient demographics, computerized orders for prescriptions, computerized orders for tests, electronic lab results, and electronic clinical notes. Robert Wood Johnson Foundation, MGH Institute for Health Policy, and George Washington University, *Health Information Technology in the United States: The Information Base for Progress*, 2006, http://www.hitadoption.org/downloads/annual_report_2006.pdf (accessed 3 July 2007).

fourths cited concerns about the loss of productivity or income during the transition.

Discussion

We assessed the rate of EHR adoption and identified barriers to EHR adoption among the universe of federally funded CHCs. Nationally, only 13 percent of CHCs have an EHR that meets minimal federal standards of functionality. Although the 2006 NAMCS physician data are not yet available to allow for direct comparison, analyses of the 2005 NAMCS data estimated that 9 percent of office-based physicians had a functional EHR in 2005, using these same criteria.²² Approximately 40 percent of physicians in the NAMCS sample are in solo practice, which makes comparisons with CHCs at this level less useful. The majority of CHCs fall in the range of having six to ten providers, including both physicians and mid-level personnel. In this range, CHCs in 2006 lagged slightly behind physician practices in 2005 with respect to EHR adoption.

■ **Importance of patient mix.** Although our data show the same significant linear relationship between size and EHR adoption as the 2005 NAMCS data in bivariate analyses (Exhibit 5), multivariate analyses demonstrated that patient-mix characteristics are the most important factors in understanding EHR adoption rates among CHCs. CHCs'

high proportion of uninsured and poor patients reflects their fragile revenue streams and financial vulnerability, as well as the increased complexity of the patients they serve. CHCs that serve the highest proportion of poor and uninsured patients, and thus have comparatively lower third-party revenues, are significantly less likely to have an EHR system. This central finding should surprise no one, given the substantial costs associated with the adoption of EHR systems, including hardware and software evaluation and implementation, staff training, and ongoing operational support.²³ These findings are punctuated by the fact that 91 percent of health centers without an EHR system cite lack of capital as the most important barrier to adoption.

■ **Dependence on public financing.** Health centers' heavy financial dependence on public grants and Medicaid payments, which in combination account for nearly 70 percent of all operating revenues, means that public financing for health IT adoption and operational support effectively will determine the extent to which these providers and their patients are able to benefit from these technological advances. Roughly half of all CHCs report negative operating margins each year.²⁴ Unlike other health care providers, health centers will not be able to shift adoption costs to private payers, nor can they be expected to have the

EXHIBIT 3
Factors Associated With Electronic Health Record (EHR) Adoption Among Community Health Centers (CHCs), 2006

Health center characteristics	Adjusted OR	95% CI	p value
Practice setting			
Rural area	1.00		
Urban area	1.81	0.93, 3.54	0.08
Region			
Northeast	1.00		
Midwest	0.72	0.30, 1.76	0.48
West	1.77	0.81, 3.89	0.15
South	2.59	1.17, 5.71	0.02
Number of health care delivery sites			
One site	0.49	0.18, 1.33	0.16
2-4 sites	0.60	0.30, 1.19	0.14
5-10 sites	0.69	0.34, 1.41	0.31
More than 10 sites	1.00		
Number of unduplicated patients served annually			
Fewer than 5,000 patients	0.56	0.22, 1.42	0.22
5,000-10,000 patients	0.75	0.37, 1.50	0.41
More than 10,000 patients	1.00		
Providers per 10,000 patients			
Above median (4.7) primary care physicians	0.76	0.46, 1.25	0.28
Above median (3.1) PAs, NPs, and CNMs	1.36	0.82, 2.27	0.23
Above median (0.7) lab and x-ray technicians	1.02	0.62, 1.66	0.95
Financial characteristics			
Revenue-to-cost ratio			
Less than 1	0.86	0.53, 1.39	0.53
More than 1	1.00		
Patients' insurance status			
Above median (13%) privately insured	1.09	0.57, 2.09	0.80
Above median (31%) Medicaid	0.97	0.53, 1.77	0.91
Above median (5%) Medicare	1.60	0.92, 2.77	0.09
Above median (38%) uninsured	0.47	0.25, 0.91	0.03
Managed care			
Above median (10%) enrolled	1.12	0.65, 1.94	0.67
Patient characteristics			
Age			
Above median (31%) ages 0-17	1.11	0.63, 1.95	0.71
Above median (60%) ages 18-64	1.36	0.73, 2.56	0.34
Above median (6%) age 65+	0.60	0.33, 1.12	0.11
Family income			
Above median (53%) with income below 100% of poverty	0.44	0.26, 0.76	0.01
Race and ethnicity			
Above median (38%) white	1.11	0.62, 1.96	0.73
Above median (7%) black	0.92	0.49, 1.71	0.79
Above median (10%) Latino	1.75	0.97, 3.16	0.06
Above median (5%) other race	1.43	0.86, 2.39	0.17

SOURCE: Derived from the authors' analyses.

NOTES: Where applicable, health centers above the median of the distribution were compared with centers below the median. N = 672. OR is odds ratio. CI is confidence interval. PA is physician assistant. NP is nurse practitioner. CNM is certified nurse midwife.

**EXHIBIT 4
Perceived Barriers To Electronic Health Record (EHR) Adoption Among Community Health Centers, 2004**

Perceived barrier	Percent rating barrier important or very important
Lack of capital to invest in EHR	91
Inability to integrate the EHR with practice's billing/claim submission system	81
Concern about loss of productivity or income during transition to EHR system	76
Currently available software does not meet the health center's needs	56
Inability to evaluate, compare, and select the appropriate EHR system	56
Added value of EHR does not justify investment	50
Lack of support from physicians	50
Lack of support from nonphysician providers	43

SOURCE: Derived from the authors' analyses.

NOTE: Exhibit summarizes results for the 87 percent of health centers (N=633) that did not have an EHR at the time of the survey.

level of access to private lending capital enjoyed by providers with robust privately sponsored operations. This is particularly the case for CHCs that serve the greatest numbers of poor and uninsured patients and that lag behind their peer CHCs in health IT adoption. CHCs will need major up-front investment to facilitate initial adoption, as well as ongoing assistance to support IT staffing and ongoing

maintenance.

Federal and state public financing payment rules could be augmented, with relative dispatch, to support both adoption and ongoing operational costs. Such federal investment in CHCs' health IT capacity would need to be above and beyond existing federal health center program funding to avoid undermining patient care. By law, health centers' Medicare

**EXHIBIT 5
Electronic Health Record (EHR) Use In Community Health Centers (CHCs) In 2006 Versus Private Practices In 2005**

Number of providers	Percent functional EHR use	
	CHC providers, 2006 ^a	NAMCS physicians, 2005
Solo	3.4	4.4
2	7.9	6.0
3-5	9.3	10.2
6-10	14.4	16.5
11 or more	21.0	20.8

SOURCE: Derived from the authors' analyses; and C. Burt, E. Hing, and D. Woodwell, "Electronic Medical Record Use by Office-Based Physicians: United States," 2005, <http://www.cdc.gov/nchs/products/pubs/pubd/hestats/electronic/electronic.htm> (accessed 25 June 2007).

NOTES: Both CHC 2006 and National Ambulatory Medical Care Survey (NAMCS) 2005 trends are significant ($p < 0.02$ and $p < 0.05$, respectively). These figures exclude radiologists, anesthesiologists, and pathologists.

^aCHC providers include physician full-time equivalents (FTEs) and one-half mid-level practitioner FTEs. Mid-level practitioners include nurse practitioners, physician assistants, and certified nurse midwives. Health Resources and Services Administration (HRSA) baseline productivity standards for federally qualified health centers calculate mid-level practitioner productivity as half that of physicians. HRSA, "Comparison of Rural Health Clinics and Federally Qualified Health Center Programs" (Sterling, Va.: HRSA, 2006).

payments are tied to cost; thus, the proportional cost of adoption and operation could be recognized in their rates.²⁵ Similarly, state Medicaid programs have the authority to adjust health centers' payment rates to recognize the proportional cost of health IT adoption for their patients.

With respect to the federal operational grants that subsidize health centers' operations for uninsured patients, supplementation clearly will be needed. Although in recent years Congress has increased financial support for health centers, Congress to date has enacted no specific supplement for health IT adoption, even though legislation passed during the summer of 2006 in both the House and the Senate placed special emphasis on such adoption among safety-net providers. Most surprisingly, perhaps, despite their federal status and the attention focused on them by the Bush administration since 2001, health centers were entirely absent from the 2006 Presidential Order issued in the summer of 2006, whose purpose was to speed health IT adoption through federal programs.

■ **Promising building blocks.** Nevertheless, there are some promising building blocks on which to expand health IT capacity among CHCs. Remarkably, 86 percent of CHCs maintain electronic disease-specific registries; 80 percent maintain an electronic patient registry as part of the HRSA-sponsored Health Disparities Collaboratives.²⁶ This experience provided CHCs with an initial foothold in the world of health IT and positions them to be leaders in demonstrating the potential of health IT to serve as a tool for monitoring and improving population health.²⁷

The CCI in California has also shown that health IT capacity among community-based clinics and health centers can be greatly increased over a short period of time with relatively modest investments (\$41 million in the case of the California initiative). During six years of funding, the initiative increased the use of disease registries, improved and updated practice management systems, and increased networking and connectivity among 163 clinics and 15 regional clinic consortia.²⁸

Kevin Fiscella and Jack Gieger have recently called for substantial federal investment in research to identify the most appropriate models for accelerating the adoption of EHR systems among CHCs and for providing the necessary funding and technical support to facilitate such adoption.²⁹ Robert Miller and Christopher West have estimated that CHCs will need \$550 million to \$1.1 billion over the next ten years to pay for EHRs, including technical and organization assistance.³⁰

■ **Health IT capacity and health disparities.** Insofar as ensuring comparable health IT capacity among providers of vulnerable populations is motivated by concern about health disparities, investment in CHCs' ability to implement EHRs to ensure that they keep pace with other provider groups seems wise. This study suggests that close attention to barriers to health IT adoption faced by that subset of CHCs serving the greatest number of poor and uninsured patients may be particularly important. Studies have documented that there are no disparities in the receipt of health services or in health status among health center patients, even after sociodemographic factors are controlled for.³¹ Further, the impact of reduced health disparities achieved by CHCs in such key areas as infant mortality, prenatal care, tuberculosis rates, and age-adjusted death rates has been associated with a reduction in health disparities statewide.³² These successes are consistent with health centers' mission to provide high-quality care that is customized to fit the needs of the largely minority communities they serve. Given that CHCs serve approximately 14 percent of the nation's uninsured people, 11 percent of Medicaid enrollees, and 10 percent of minorities, investing in expanding CHCs' health IT capacity seems a valuable strategy to further reduce health disparities for a substantial number of financially vulnerable patients.

■ **Study limitations.** Results of this study must be viewed within the context of study limitations. Survey data were self-reported and were not audited. Interpretation of our results and our ability to place the current findings in context with respect to other provider

groups are limited by the lack of contemporaneous published estimates for other provider groups. The most current estimates of EHR adoption among physicians is for 2005. Once available, the 2006 NAMCS estimates of self-reported EHR adoption and EHR adoption according to recommended national standards for minimal functionalities will provide important context. Assessment of family income was missing for 26 percent of CHC patients nationally; however, there is no evidence that this biased our results. Despite these limitations, this study provides the first national estimates of EHR adoption and barriers to adoption among CHCs and useful information for developing policies to ensure that access to improved quality and safety of health care will not be denied to those patients served by this critical group of safety-net providers.

IN LOOKING TO THE FUTURE, it appears that investment in health IT among CHCs provides a real opportunity to further improve the health of a sizable number of vulnerable patients and reduce health disparities, both now and perhaps even more so in the anticipated future of genomic medicine. Monitoring the diffusion of health IT among providers that disproportionately care for underserved populations must be a central part of any comprehensive strategy to reduce health disparities in the United States.

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NOTES

1. The field of research on health IT adoption is changing rapidly, and there is little consensus in the field regarding terminology, definitions, and nomenclature. The terms *electronic health record* (EHR) and *electronic medical record* (EMR) are often used interchangeably. In this paper we follow the practice of the national HIT Adoption Initiative and use "EHR" consistently. A. Jha et al., "How Common Are Electronic Health Records in the United States? A Summary of the Evidence," *Health Affairs* 25 (2006): w496-w507 (published online 11 October 2006; 10.1377/hlthaff.25.w496); D.W. Bates and A.A. Gawande, "Improving Safety with Information Technology," *New England Journal of Medicine* 348, no. 25 (2003): 2526-2534; and R. Kaushal, K.G. Shojania, and D.W. Bates, "Effects of Computerized Physician Order Entry and Clinical Decision Support Systems on Medication Safety: A Systematic Review," *Archives of Internal Medicine* 163, no. 12 (2003): 1409-1416.
2. B.D. Smedley, A.Y. Stith, and A.R. Nelson, eds., *Unequal Treatment: Confronting Racial and Ethnic Disparities in Health Care* (Washington: National Academies Press, 2003); and Robert Wood Johnson Foundation, MGH Institute for Health Policy, and George Washington University, *Health Information Technology in the United States: The Information Base for Progress*, 2006, http://www.hitadoption.org/downloads/annual_report_2006.pdf (accessed 3 July 2007).
3. B.E. Landon et al., "Improving the Management of Chronic Disease at Community Health Centers," *New England Journal of Medicine* 356, no. 9 (2007): 921-934.
4. U.S. Department of Health and Human Services, "Request for Information (RFI): Improving Health and Accelerating Personalized Health Care through Health Information Technology and Genomic Information in Population- and Community-Based Health Care Delivery Systems," 30 October 2006, <http://www.aspe.hhs.gov/PHC/rfi/v11.cfm> (accessed 20 November 2006).
5. C. Burt, E. Hing, and D. Woodwell, "Electronic Medical Record Use by Office-Based Physicians: United States, 2005," August 2006, <http://www.cdc.gov/nchs/products/pubs/pubd/hestats/electronic/electronic.htm> (accessed 25 June 2007); and Jha et al., "How Common Are Electronic Health Records?"
6. T.G. Ferris et al., "Are Minority Children the Last to Benefit from a New Technology? Technology Diffusion and Inhaled Corticosteroids for Asthma," *Medical Care* 44, no. 1 (2006): 81-86; and P.W. Groeneveld, S.B. Laufer, and A.M. Garber,

- “Technology Diffusion, Hospital Variation, and Racial Disparities among Elderly Medicare Beneficiaries: 1989–2000,” *Medical Care* 43, no. 4 (2005): 320–329.
7. M.E. Lewin and S. Altman, eds., *America's Health Care Safety Net: Intact but Endangered* (Washington: National Academies Press, 2000).
 8. National Association of Community Health Centers, “The Safety Net on the Edge,” August 2005, <http://www.nachc.org/research/Files/SNreport2005.pdf> (accessed 3 July 2007); and J. Taylor, “The Fundamentals of Community Health Centers,” NHPF Background Paper, 31 August 2004, http://www.gwu.edu/sphhs/healthpolicy/ggprogram/BP_CHC_08-31-04.pdf (accessed 3 July 2007).
 9. Taylor, “The Fundamentals.”
 10. NACHC, “The Safety Net”; and NACHC, *A Sketch of Community Health Centers: Chart Book*, 2006, <http://www.nachc.org/research/Files/ChartBook2006.pdf> (accessed 25 June 2007).
 11. NACHC, “The Safety Net”; and J.S. McAlearney, “The Financial Performance of Community Health Centers, 1996–1999,” *Health Affairs* 21, no. 2 (2002): 219–225.
 12. DHHS, Health Resources and Services Administration, Uniform Data System, 1999–2005, <http://bphc.hrsa.gov/uds/nationaldata.htm> (accessed 17 July 2007).
 13. Community Clinics Initiative, *Celebrating Technology Advances in California's Community Clinics and Health Centers*, 2006, http://www.communityclinics.org/files/887/Getting_to_the_Sun_Commemorative_Book.pdf (accessed 3 July 2007); and K. Guthrie and A. Nalley, “Moving from Data Collection to Health Promotion: Lessons on the Information Management Capacity of California's Community Clinics and Health Centers Drawn from the First Year of the Community Clinics Initiative” (San Francisco: Tides Foundation, 2001).
 14. D. Gaylin et al., *Community Health Center Information Systems Assessment: Issues and Opportunities: Final Report*, October 2005, <http://aspe.hhs.gov/sp/chc/chc.pdf> (accessed 3 July 2007).
 15. For a sample survey form, see National Center for Health Statistics, National Ambulatory Medical Care Survey, 2006 Panel, <http://www.cdc.gov/nchs/data/ahcd/namcs1-2006.pdf> (accessed 25 June 2007).
 16. D. Gans et al., “Medical Groups' Adoption of Electronic Health Records and Information Systems,” *Health Affairs* 24, no. 5 (2005): 1323–1333; CCI, “2005 Information Management Assessment Survey, Executive Director Version,” http://hitadoption.org/uploads/questionnaires/CCI_ED_survey_2005.pdf; and “Medical Director Ver-
sion,” http://hitadoption.org/uploads/questionnaires/CCI_MD_survey_2005.pdf (both accessed 17 July 2007).
 17. Further details are available in the survey methodology section of the Technical Appendix, available online at <http://content.healthaffairs.org/cgi/content/full/26/5/1373/DC1>.
 18. Centers for Disease Control and Prevention, “Ambulatory Health Care Data,” 30 October 2006, <http://www.cdc.gov/nchs/about/major/ahcd/ahcd1.htm> (accessed 20 November 2006).
 19. RWJF, MGH Institute, and GWU, *Health Information Technology*.
 20. A complete description of the methods can be found in the statistical methods section of the online Technical Appendix; see Note 17.
 21. An unabridged version of Exhibit I can be found in the online Technical Appendix; *ibid*.
 22. Burt et al., “Electronic Medical Record Use.”
 23. R. Hillestad et al., “Can Electronic Medical Record Systems Transform Health Care? Potential Health Benefits, Savings, and Costs,” *Health Affairs* 24, no. 5 (2005): 1103–1117.
 24. McAlearney, “The Financial Performance.”
 25. Sec. 1833(f) of the *Social Security Act*.
 26. Landon et al., “Improving the Management.”
 27. D.W. Bates et al., “A Proposal for Electronic Medical Records in U.S. Primary Care,” *Journal of the American Medical Informatics Association* 10, no. 1 (2003): 1–10.
 28. CCI, *Celebrating Technology Advances*.
 29. K. Fiscella and H. Geiger, “Health Information Technology and Quality Improvement for Community Health Centers,” *Health Affairs* 25, no. 2 (2006): 405–412.
 30. R.H. Miller and C.E. West, “The Value of Electronic Health Records in Community Health Centers: Policy Implications,” *Health Affairs* 26, no. 1 (2007): 206–214.
 31. K. Frick and J. Regan, “Whether and Where Community Health Center Users Obtain Screening Services,” *Journal of Health Care for the Poor and Underserved* 12, no. 4 (2001): 429–445; and A. O'Malley et al., “Health Center Trends, 1994–2001: What Do They Portend for the Federal Growth Initiative?” *Health Affairs* 24, no. 2 (2005): 465–472.
 32. P. Shin, K. Jones, and S. Rosenbaum, “Reducing Racial and Ethnic Health Disparities: Estimating the Impact of High Health Center Penetration in Low-Income Communities,” Fact Sheet, October 2004, <http://www.nachc.org/advocacy/HealthDisparities/files/DisparitiesFactSheet.pdf> (accessed 3 July 2007).