Where's the Revolution? Digital Technology and Health Care in the Internet Age

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Abstract Despite the growing use of online resources, it is unclear how many Americans are using the World Wide Web for different health-related purposes and whether factors promoting use of the Internet in health care correspond with those affecting more traditional in-person and telemedicine encounters. This research uses a national public opinion survey to examine the degree to which health care consumers communicate through conventional, face-to-face consultation, telemedicine, or digital technology, and the relationship between these means of communication and respondent characteristics. Results indicate that few people are using digital technology to get information, communicate with health personnel, or make online medical purchases. Furthermore, less well educated, lower-income individuals living in rural areas tend to use the health care Internet less than others. Several policy measures need to be undertaken in order to accelerate the appropriate use of digital technology by health care consumers of all kinds. These include improving education and technological literacy and providing access to low-cost digital technology. Without a consumer complement to prevailing efforts to spur health information technology development and implementation on the part of providers, the promise of the digital revolution will continue to be limited to certain better-connected segments of the population.

Governments, hospitals, doctors, and pharmaceutical manufacturers have placed a tremendous amount of medical information, data, and services online in recent years (Audet et al. 2004; Eysenbach et al. 2002). This is reflected in the rapid rise in health information technology (HIT) expenditures, which, according to the American Hospital Association, grew from $19 to $31 billion between 2000 and 2006 (Garber 2006). Given concerns

Journal of Health Politics, Policy and Law, Vol. 34, No. 2, April 2009
DOI 10.1215/03616878-2008-046

over health care quality, affordability, and accessibility, national leaders also see the use of Internet Web sites, broadband access, e-mail communications, and electronic transmissions of patient data as valuable tools for improving the efficiency and effectiveness in the health care system.

In 2004, President George W. Bush signed an executive order creating the position of national health information technology coordinator (White House 2004). This individual is charged with the responsibility of awarding funds to technology standard–setting entities as well as to states and regional health information organizations to implement various data-sharing strategies (U.S. General Accountability Office 2005). This is an important policy change: U.S. government investment in HIT, at $125 million so far, has lagged far behind that of nations such as the United Kingdom ($11.5 billion), Germany ($1.8 billion), and Canada ($1.0 billion) (Anderson et al. 2006). Ultimately, the goal is to promote the adoption of electronic health records (EHRs) and other technologies to aid in electronic results viewing, diagnostic support, computerized order entry and verification, and other functions.

The application of information technology to health care has very broad appeal, crossing both sides of the political aisle. Former U.S. House Speaker Newt Gingrich (Gingrich, Pavey, and Woodbury 2003) suggests that EHRs and digital communications with doctors can empower patients while reducing medical errors. Senator Hillary Rodham Clinton (2008) unveiled a plan for universal coverage that would be paid for, in part, through administrative efficiencies derived from more widespread adoption of HIT. There has also been growth in the policy community concerned with digital health care: public officials, academics, consultants, business analysts, and others are being brought together under the auspices of organizations such as the American Health Information Management, American Medical Informatics, and American Telemedicine Associations. By publishing articles, presenting testimony, attending conferences, and drafting legislation, advocates have attempted to influence the direction of government policy in this area.

Although it may be too early to truly assess the impact of health information technology (Himmelstein and Woolhandler 2005), research suggests that HIT could result in considerable savings through improved efficiency, safety, prevention, and chronic disease management (Hillestad et al. 2005). It also suggests that HIT could increase satisfaction with communication, convenience, and overall care while linking traditionally underserved groups and communities to previously inaccessible providers (Lin et al. 2005). But despite the long-run potential, there remain barri-

ers to successful implementation (Miller 2007). The health sector is a highly politicized area, and there is intense conflict between major interests. Furthermore, responsibility is shared among fragmented financing and service delivery systems, which slows the pace of change. Reform is further complicated by a digital divide that prevents many populations from benefiting from recent advances. Technical issues, implementation costs, and ethical dilemmas also make it difficult for society to take full advantage of new modes of digital communication.

Especially salient to providers are financial concerns associated with reimbursement, long-term funding, and other expenditures (Middleton 2005; Rutland, Marie, and Rutland 2004). There are also nonfinancial costs that limit provider enthusiasm, including time, staff, and other resources devoted to learning new systems, in addition to possible workload increases if new technologies complement rather than replace in-office visits (Miller and Sim 2004). Lack of standardization and the piecemeal development of the telecommunications infrastructure in health care is another important obstacle (Kleinke 2005).

In this article, we examine limits placed on the HIT revolution by consumer usage and attitudes. National estimates indicate that somewhere between 50 and 80 percent of adult Internet users search for health information and advice online (Baker et al. 2003; Brodie et al. 2000; Fox 2005a; Ybarra and Suman 2006; Rice 2006). Indeed, the number of Americans using the Internet to search for health care information nearly doubled from 50 to 95 million between 2000 and 2004 (Fox and Fallows 2003; Fox 2005a). Embedded in much of the discussion over HIT is concern over the extent to which it serves as a substitute for rather than a complement to conventional health system contact (Blumenthol 2002). While the amount of information has risen dramatically, there are few standards governing the provision of online materials, and some information is incomplete or inaccurate or is sponsored by pharmaceutical interests with a financial stake in particular treatments (Eysenbach et al. 2002; Miller and West 2007).

Despite data profiling the growing availability and use of online resources among Internet users, it is still unclear how many Americans are using the World Wide Web to communicate with providers, acquire health care information, or make online purchases. It is also unclear how many are using digital technology in place of conventional modes of medical communication and whether the characteristics of those who turn to the Internet for health-related purposes are different from those who do not. The present study, therefore, uses national public opinion data to (1)

examine the degree to which health care consumers seek health information through conventional, face-to-face consultation, telemedicine, or digital technology (Web site visits, e-mail, and online purchases), while (2) comparing the relationship between these means of communication and demographic factors and health care perceptions.

Methods

This study is based on a national survey of 1,428 adults eighteen years or older in the continental forty-eight states conducted from November 5 to 10, 2005. Surveys were administered by trained and paid interviewers at the John Hazen White Sr. Public Opinion Laboratory at Brown University. The sample was provided by a commercial sampling firm. It was based on a randomly generated set of telephone numbers stratified by state. The margin of error was plus or minus three percentage points, assuming simple random sampling. Up to three callbacks were placed to reach prospective respondents. Of 3,725 eligible households, 1,428 answered the telephone, providing us with a contact rate of 38.3 percent, including 500 who refused to participate and 928 who completed the survey. Thus, we received responses from approximately 25.0 percent of all eligible households (3,725) and 65.0 percent of households contacted (1,428).

Outcome Measures: Health Communication

Respondents were asked how often in the past year they had visited, called, or e-mailed a physician or other health care professional, visited a health-related Web site, or ordered prescription drugs or medical equipment online. Specific categories included: "not at all," "every few months or less," "once a month," and "once or more a week." Because few indicated monthly or weekly digital use, outcome variables were coded dichotomously, indicating those who did and did not engage in each communication behavior during the prior year. For a subset of analyses, three category variables were used to describe in-person visits and telephone calls.

Covariates: Respondent Characteristics

Conceptualizing communication behavior as a form of utilization, we organize the predictors of health care communication according to Andersen's behavioral model of health services. Andersen posits that an indi-

vidual's use of health services is a function of predisposing, enabling, and need characteristics (Andersen 1995). We measure need — or one's state of health or illness — by asking respondents to rate their current health as "very poor," "poor," "fair," "good," "very good," or "excellent." We measure enabling characteristics, or indicators of personal/family and community resources, using insurance status (uninsured, insured), income (seven categories), and place of residence (rural, urban/suburban).

We measure predisposing characteristics using demographic, social structure, and health belief indicators. Demographic factors include age (eight categories) and gender. Social structure includes education (six categories) and ethnicity (non-Hispanic white, other). We measure values toward health and disease using reported frequency of three lifestyle behaviors: smoking, exercising, and eating a balanced diet. We employ five-point scales running from "not at all" to "every meal"/"several times a day." Due to a lack of variation, smoking was coded dichotomously. We measure health literacy using three specially designed survey items — confidence filling out forms, inability to read materials without help, and difficulty understanding written information (Chew, Bradley, and Boyko 2004). Principal components analysis confirmed creation of an index averaging these three items (Croenbach alpha = .61).

To measure respondent attitudes toward health services, we rely on nine items modified from the short-form Patient Satisfaction Questionnaire (PSQ-III) (Grant, Marshall, and Hays 1994). Principal components analysis revealed three distinct factors. The first factor included two questions about affordability: worry about affording health care ("very worried," "somewhat worried," "not very worried") and problems paying medical bills ("yes," "no"). The second factor included two questions about access: difficulty getting appointments and ability to get medical care whenever needed. The third factor included five questions about quality: doctors hurrying too much, providing complete care, making correct diagnoses, being careful to check everything, and acting too businesslike/impersonal. Questions about access and quality were measured using five-point Likert scales, with response categories ranging from "strongly agree" to "strongly disagree." We used the average of the individual items to create the overall indices for these two concepts (alphas = .64 and .70, respectively). We did the same to generate the overall index for affordability, but because the two items were based on different scales, we first standardized them around their means before taking the average (alpha = .57).

Analysis

Analysis proceeded in several steps. First, we identified the percentage of respondents engaging in each communication behavior during the previous year. Second, we used χ^2 tests to examine relationships among the communication behaviors examined and to compare univariate associations between communication behavior and respondent characteristics and attitudes. Fourth, we used logistic regression to estimate adjusted odds ratios describing the relationship between each of the communication modes and the independent variables. For purposes of these analyses we employed multiple imputation of missing data. The number of missing values ranged from only 3 to 81 for all variables but income. At 222, or 23.9 percent, however, a significant portion failed to report income—a common occurrence in social research (Battaglia et al. 2002). Multiple imputation replaces each missing value with a set of plausible values. Here we used the Markov Chain Monte Carlo method to create $M = 20$ complete data sets by replacing missing values with simulated values. Variation across these completed data sets reflected the uncertainty deriving from imputation (Raghunathan 2004). All variables subsequently used in our analysis models were included in our imputation model, which we implemented using PROC MI in SAS 9.1. Next, we separately analyzed each of the 20 complete data sets using logistic regression. These results were combined using PROC MIANALYZE.

Results

Approximately 87.1 percent of our sample reported visiting a doctor or other health care provider during the previous year; 47.4 percent that they had telephoned. In comparison, 31.1 percent reported seeking health information online and 7.5 percent that they had made an online purchase, whether prescription drugs (6.4 percent) or medical equipment or devices (2.0 percent). Only 4.6 percent reported using e-mail to communicate with a physician or caregiver.

Overall, results indicate that individuals who employed any one of the health communication strategies examined were more likely to employ the others (table 1). Thus, respondents who visited health Web sites, for example, were more likely to make online purchases, or call, e-mail, or visit providers in person than individuals who did not seek health information online. Results also indicate that respondents who used the Internet for one purpose (e.g., Web site visits) were more likely to use it for the

Table 1 Relationships among Medical Communication Technologies

	Personal Visit	Phone Call	E-mail	Web Site Visit	Online Purchase
Personal visit	—				
No (%)	—	15.7	0.0	22.1	2.8
Yes	—	52.8	5.2	33.9	8.3
	—	$p = .000$***	$p = .015$*	$p = .016$*	$p = .042$*
Phone call		—			
No (%)	80.4	—	3.0	25.3	5.6
Yes	96.1	—	6.4	41.3	9.8
	$p = .000$*	—	$p = .014$*	$p = .000$***	$p = .016$*
E-mail			—		
No (%)	87.6	47.2	—	31.2	6.8
Yes	100.0	66.7	—	66.7	23.3
	$p = .015$*	$p = .014$*	—	$p = .000$***	$p = .000$***
Web site visit				—	
No (%)	86.3	41.7	2.2	—	2.9
Yes	91.9	59.8	9.0	—	15.5
	$p = .016$*	$p = .000$***	$p = .000$***	—	$p = .000$****
Online purchase					—
No (%)	87.4	47.2	3.9	29.4	—
Yes	95.7	62.3	14.5	72.1	—
	$p = .042$*	$p = .016$*	$p = .000$***	$p = .000$***	—

Source: Brown University National Public Opinion E-Health Survey, November 5–10, 2005.

*Chi-square, *** $p < .001$; ** $p < .01$; * $p < .05$; † $p < .10$

other two (e-mail, online purchases) compared to individuals who communicated in person or over the telephone. All who used e-mail reported in-person visits. Furthermore, respondents who made in-person visits were much more likely to telephone, e-mail, and make online purchases; smaller differences were observed for Web site visits. Whereas no respondents reported using e-mail unless they had also seen a physician or other provider in person, and only 2.8 percent made an online purchase without having in-person contact, a little more than one-fifth (22.1 percent) searched for health information online even if they did not report an in-person consultation during the previous year (table 2). Moreover, in contrast to the percentage of e-mailers and online purchasers, which rose as the frequency of in-person contact increased from "every few months or

Table 2 Digital Communication and the Level of Conventional Communication Use

	E-mail	Web Site Visit	Online Purchase
Personal visit			
No (%)	0.0	22.1	2.8
Every few months	4.7	35.2	7.0
Once a month/more	6.8	29.9	11.8
	$p = .023$*	$p = .022$*	$p = .011$*
Phone call			
No (%)	3.0	25.3	5.6
Every few months	6.2	42.6	9.3
Once a month/more	7.4	35.5	12.3
	$p = .043$*	$p = .000$***	$p = .035$*

Source: Brown University National Public Opinion E-Health Survey, November 5–10, 2005.

*Chi-square, *** $p < .001$; ** $p < .01$; * $p < .05$; † $p < .10$

less" to "once a month or more," the percentage visiting health Web sites declined.

Table 3 reports characteristics of respondents engaging in each form of health care communication. Although there were no significant associations between education, income, and residence and conventional communication behavior, better-educated respondents with higher incomes living in urban/suburban areas were more likely than less well educated respondents with lower incomes living in rural areas to report e-mailing providers, visiting Web sites, or making online purchases. By contrast, being insured increased the chances of visiting a provider in person or over the telephone but had no significant association with digital communication use. Whereas older people were more likely to make in-person visits, they were less likely to visit health care Web sites. In contrast, middle-aged respondents were more likely to make online purchases. Women were also more likely than men to make in-person visits or telephone calls or to visit health Web sites. Those in increasingly poorer health were more likely to e-mail and communicate conventionally. Whereas respondents with stronger health literacy were more likely to visit health Web sites, those with healthier lifestyle behaviors were more likely to e-mail or make in-person visits or telephone calls. Individuals communicating via the telephone tended to have more negative attitudes toward health care costs and quality; those visiting health Web sites tended to have more negative attitudes toward costs and access.

Table 3 Variation in Use of Medical Communications Technology by Subgroup

	Personal Visit	Phone Call	E-mail	Web Site Visit	Online Purchase
Age					
18–44 (%)	85.3	49.1	4.3	39.3	6.9
45–64	87.9	46.5	6.0	39.0	10.3
65+	93.8	50.5	3.4	33.0	2.9
	$p = .012$*	$p = .636$	$p = .344$	$p = .000$***	$p = .005$**
Gender					
Male (%)	83.5	38.7	4.0	26.1	7.9
Female	91.1	54.7	4.9	37.0	7.5
	$p = .001$**	$p = .000$***	$p = .492$	$p = .001$**	$p = .803$
Race					
White (%)	90.0	48.0	4.6	33.7	7.5
Nonwhite	83.6	48.1	6.0	31.0	7.3
	$p = .019$*	$p = .967$	$p = .425$	$p = .514$	$p = .919$
Education					
0–11 years (%)	88.5	43.0	5.1	9.0	3.8
12 years	86.2	43.9	3.5	17.9	3.9
13–16 years	89.4	50.1	4.2	42.1	6.5
17+ years	89.0	52.6	8.6	53.3	18.2
	$p = .631$	$p = .228$	$p = .122$	$p = .000$***	$p = .000$***
Cost perceptions					
Positive (%)	90.3	48.3	4.5	33.2	7.1
Moderate	84.2	34.9	6.2	27.7	6.2
Negative	86.1	61.3	4.2	39.7	9.6
	$p = .070$	$p = .000$***	$p = .661$	$p = .086$†	$p = .455$
Access perceptions					
Positive (%)	90.3	49.0	4.2	29.7	5.8
Moderate	86.7	45.8	7.0	36.0	9.1
Negative	90.7	54.8	2.5	45.5	11.0
	$p = .301$	$p = .285$	$p = .112$	$p = .004$**	$p = .071$
Quality perceptions					
Positive (%)	91.8	48.1	5.9	30.3	4.8
Moderate	88.9	47.7	4.0	33.1	9.3
Negative	87.8	67.1	6.7	43.7	5.5
	$p = .390$	$p = .008$**	$p = .388$	$p = .105$	$p = .060$†
Exercise					
Not at all (%)	86.6	43.2	5.0	25.3	6.9
Occasionally	88.9	49.1	4.8	38.6	8.9
Daily	87.9	49.2	4.6	31.2	6.6
	$p = .753$	$p = .402$	$p = .976$	$p = .009$**	$p = .478$

(*continued*)

Table 3 Variation in Use of Medical Communications Technology by Subgroup (*continued*)

	Personal Visit	Phone Call	E-mail	Web Site Visit	Online Purchase
Balanced diet					
Not at all (%)	84.0	36.0	1.4	26.4	8.0
Occasionally	87.0	48.2	2.4	30.2	8.9
Daily/every meal	89.2	50.6	5.7	34.6	7.2
	$p = .344$	$p = .057$†	$p = .065$†	$p = .263$	$p = .733$
Smokes					
No (%)	89.2	49.0	5.3	33.4	8.1
Yes	83.9	45.4	1.7	30.9	5.6
	$p = .053$†	$p = .389$	$p = .039$*	$p = .517$	$p = .275$
Health literacy					
Poor/fair (%)	85.4	51.2	7.3	17.1	7.3
Good	86.5	54.2	8.1	22.2	8.1
Very good	94.7	57.0	2.6	30.0	7.0
Excellent	87.0	44.3	4.8	37.7	7.5
	$p = .013$*	$p = .011$*	$p = .185$	$p = .003$**	$p = .988$
Income					
0–30K (%)	83.1	47.6	3.8	20.3	2.63
0–75K	88.6	46.3	3.7	39.6	10.2
75–100K	92.3	56.6	6.4	49.3	7.9
>100K	89.1	48.9	9.6	52.8	14.9
	$p = .104$	$p = .452$	$p = .095$†	$p = .000$***	$p = .001$**
Health insurance					
No (%)	71.9	37.7	3.2	27.5	5.7
Yes	91.0	49.8	5.0	34.3	7.6
	$p = .000$***	$p = .013$*	$p = .386$	$p = .146$	$p = .458$
Urban					
Rural (%)	87.4	47.9	1.7	27.7	4.4
Urban/suburban	89.1	47.8	6.0	36.3	8.9
	$p = .461$	$p = .961$	$p = .004$**	$p = .013$*	$p = .017$*
Perceived health					
Very poor/poor (%)	93.2	70.2	8.5	24.6	5.1
Fair	89.3	51.9	8.3	25.2	9.9
Good	93.2	51.1	3.4	31.9	6.8
Very good	87.4	41.8	4.0	38.5	8.1
Excellent	79.7	44.1	3.7	33.9	7.4
	$p = .000$***	$p = .001$**	$p = .113$	$p = .056$†	$p = .764$

Source: Brown University National Public Opinion E-Health Survey, November 5–10, 2005.

*Chi-square, *** $p < .001$; ** $p < .01$; * $p < .05$; † $p < .10$

Table 4 reports combined results from twenty logistic regression models predicting use of each health communication mode during the previous year. The models fit the data very well, and there was no problematic multicollinearity. Covariates representative of at least two Andersen model elements proved to have significant relations to each. Older individuals were significantly less likely to seek health care information online than younger individuals; women were twice as likely to visit in person or make a telephone call and 73.0 percent more likely to seek health information online. Better-educated respondents were also more likely to make telephone calls or Web site visits in addition to online purchases. No significant associations existed between race/ethnicity and any of the five communication modes studied.

Findings indicate that individuals with more negative attitudes toward health care costs were more likely to visit health Web sites, make online purchases, and telephone a physician or other provider. Similarly, individuals with more negative perceptions toward access were more likely to look for health information online. Whereas individuals with stronger health literacy were less likely to telephone a health care provider, those reporting more frequent exercise and healthier eating habits were more likely to telephone and e-mail, respectively.

Respondents with higher incomes were more likely to contact providers in person, visit health Web sites, and make online purchases. Whereas respondents with health insurance were three times more likely to report visiting a health care provider in person, and nearly three-quarters more likely do so over the telephone, individuals living in urban/suburban neighborhoods were more than three times more likely to e-mail providers and nearly three-quarters more likely to make online purchases and one-third more likely to visit health Web sites. Better perceived health proved inversely related to each communication mode, though only significantly so to e-mail, telephone use, and in-person visits.

Implications

Digital technologies are transforming many areas of human endeavor, from commerce and entertainment to government and communications. However, our results clearly indicate that the e-health revolution is progressing slowly. As a sign of the slow pace of technology adoption, we found a much higher percentage of respondents reporting conventional in-person and telephone contact with health care personnel than e-mail contact, Web

Table 4 Logistic Regression of Predisposing, Enabling, and Need Factors on Use of Medical Communications Technology

	Personal Visit	Phone Call	E-mail	Web Site Visit	Online Purchase
>Age	.104 (.069) [1.11]	−.010 (.045) [0.99]	−.077 (.110) [0.93]	−.199 (.053)*** [0.82]	−.021 (.098) [0.98]
Female	.718 (.224)** [2.05]	.620 (.149)*** [1.86]	.106 (.348) [1.11]	.550 (.170)** [1.73]	.012 (.274) [1.01]
Nonwhite	−.270 (.282) [0.76]	.151 (.200) [1.16]	.404 (.431) [1.50]	−.110 (.226) [0.90]	.009 (.375) [1.01]
>Education	−.008 (.107) [0.99]	.143 (.070)* [1.15]	.083 (.157) [1.09]	.444 (.082)*** [1.56]	.330 (.131)* [1.39]
<Cost perceptions	−.003 (0.154) [1.00]	.189 (.101)† [1.21]	.115 (.233) [1.12]	.228 (.115)* [1.26]	.374 (.183)* [1.45]
<Access perceptions	0.157 (0.144) [1.17]	.031 (.087) [1.03]	.083 (.200) [1.09]	.174 (.095)† [1.19]	.138 (.153) [1.15]
<Quality perceptions	−.297 (.190) [0.74]	.029 (.110) [1.03]	−.219 (.251) [0.80]	−.014 (.124) [0.99]	.144 (.198) [1.15]
>Exercise	.061 (.078) [1.06]	.109 (.050)* [1.11]	−.007 (.116) [0.99]	.002 (.057) [1.00]	.028 (.096) [1.03]
>Balanced diet	.012 (.079) [1.01]	.074 (.053) [1.08]	.480 (.181)** [1.62]	.039 (.061) [1.04]	−.109 (.092) [0.90]
Smokes	−.162 (.272) [0.85]	−.078 (.189) [0.93]	−.818 (.624) [0.44]	.054 (.209) [1.06]	−.264 (.387) [0.77]
>Health literacy	−.158 (.150) [0.85]	−.233 (.096)* [0.79]	−.169 (.198) [0.84]	.137 (.113) [1.15]	−.099 (.181) [0.91]
Income	0.150 (0.88)† [1.16]	.097 (.060) [1.10]	.191 (.134) [1.21]	.182 (.064)** [1.20]	.296 (.102)** [1.34]
Health insurance	1.11 (.303)*** [3.03]	.538 (.157)* [1.71]	.254 (.612) [1.29]	.081 (.269) [1.08]	−.068 (.461) [0.93]
Urban	.147 (.249) [1.16]	−.053 (.157) [0.95]	1.13 (.510)* [3.11]	.323 (.176)† [1.38]	.551 (.334)† [1.73]
>Perceived health	−.430 (.113)*** [0.65]	−.312 (.070)*** [0.73]	−.438 (.151)** [0.65]	−.088 (.077) [0.92]	−.120 (.124) [0.89]
Constant	2.24 (1.26)† [9.45]	−1.023 (.820) [0.36]	−4.79 (2.08)* [0.01]	−4.24 (.966)*** [0.01]	−4.69 (1.60)** [0.01]
Pseudo R-square	.148 (.137–.162)	.106 (.099–.115)	.128 (.107–.154)	.213 (.203–.222)	.121 (.109–.137)
−2 log likelihood	595.1	1,185.8	309.8	970.06	449.73
	(583.3–601.4)***	(1,178–1,190)***	(302.0–316.8)***	(963.4–977.1)***	(441.1–449.7)***
N	917	910	923	883	920

*** $p < .001$; ** $p < .01$; * $p < .05$; † $p < .10$

Note: Table reports logistic regression coefficients, with the standard errors in parentheses and odds ratios in brackets. These derive from logistic regression models analyzed independently from twenty replicate data sets generated from multiple imputation combined using Proc MIANALYZE in SAS. Mean pseudo R-square and −2 log likelihood statistics generated from the twenty replicate data sets are reported, with minimum and maximum values in parentheses. Overall significance was consistent across all twenty models estimated for each dependent variable.

Source: Brown University National Public Opinion E-Health Survey, November 5–10, 2005.

site visits, or online purchases. The percentage visiting health Web sites (31.1 percent) approximates figures from other national surveys, including those from the PEW Internet and American Life Project (30 to 38.0 percent) (Fox 2005a; Rice 2006), Brodie et al. 2000 (31.0 percent), and Ybarra and Suman 2006 (41.0 percent). The low percentages e-mailing and purchasing prescription drugs online are also similar to previous reports (Baker et al. 2003; Fox and Fallows 2003).

The number of people using the Internet to search for health information far exceeds the number using it to communicate with health care providers. This may be related less to the behavior of consumers themselves than to the choices of the providers who serve them. The Internet as a source of health information is well developed, and consumers may access it on their own without prior knowledge or assistance from their physicians or other clinicians. By contrast, consumers can contact providers digitally only if providers make that possibility available to them. Since very few physicians — 3 percent, according to one nationally representative study (Audet et al. 2004) — report using e-mail to communicate with patients, it makes sense that relatively few consumers elect to communicate with providers in this manner.

More often than not, one communication form serves to complement rather than substitute for the other communication forms. This is reflected in the finding that individuals who employed any one technology — whether conventional or digital — were significantly more likely to employ the others. However, evidence suggests that a certain degree of substitution may be taking place as well. Not only were respondents more likely to visit health Web sites independently of conventional health system contact, but they were also more likely to do so as the frequency of conventional contact declined, suggesting that Web site visits may serve as substitutes for conventional contact, at least part of the time. This is in contrast to e-mail and online purchases, which correlated more strongly with in-person contact, possibly because they are more contingent on provider cooperation — whether it is to make the former available to patients, as discussed above, or to write the prescriptions necessary to effectuate the latter.

Multivariate findings indicate that efforts to promote digital communication use will need to focus more on some populations than others. Women tend to coordinate health services for both themselves and their families. They also suffer from greater morbidity and poorer health outcomes (Misra 2001). Thus, it should not be surprising that we found a positive relationship between being female and engaging in both conven-

tional and digital health-seeking behavior. This dynamic is also reflected in previous studies, which indicate that women are not only more likely to visit a physician or other health care professional than men (Lethbridge-Cejku, Rose, and Vickerie 2006) but are also more likely to visit health care Web sites (Baker et al. 2003; Brodie et al. 2000; Fox 2005a; Rice 2006; Ybarra and Suman 2006).

As with in-person and telephone contact (Jordan, Ong, and Croft 2003), respondents in poorer health were more likely to e-mail health care providers; this, too, reinforces findings from earlier work (Baker et al. 2003; Rice 2006). Although we failed to detect significant relationships between respondent health beliefs and in-person medical encounters, we identified associations between respondent attitudes toward health care costs and lifestyle and other medical communication forms. Not only do these findings support the expectation that individuals who are more attuned to their health are more likely to contact providers via telephone or e-mail; they also support the expectation that individuals with greater difficulty affording care are more likely to seek alternative sources of information, advice, and supplies online.

Consistent with other studies, our results indicate that respondents who sought health information over the Internet tended to be younger than those who did not (Baker et al. 2003; Diaz et al. 2002; Ybarra and Suman 2006), whereas those visiting health professionals in person tended to be older, at least according to our bivariate results (Lethbridge-Cejku, Rose, and Vickerie 2006). We also found significant inequities in digital communication usage. Even after controlling for other factors, less well educated, rural-dwelling respondents with lower incomes were less likely to report visiting health Web sites or making online purchases. Rural-dwelling respondents were also less likely to e-mail.

That better-educated individuals are more likely to search for health information online is perhaps the most consistent finding across multivariate studies of Internet health utilization to date (Baker et al. 2003; Diaz et al. 2002; Dickerson et al. 2004; Ybarra and Suman 2006). In contrast to two studies — Dickerson et al. 2004 and Ybarra and Suman 2006 — we failed to find a significant association between race and Web site usage. One of these, however, Dickerson et al. 2004, was not nationally representative. The other, Ybarra and Suman 2006, neglected to include income as a predictor. This is important because available evidence indicates that racial differences in Internet use disappear after controlling for other factors such as income and education (Brodie et al. 2000; Fox and Fallows 2003), though evidence suggests that the effects of respondent character-

istics may vary across racial and ethnic groups (Miller, West, and Wasserman 2007). That insurance coverage predicted conventional but not digital communication behavior implies that while being uninsured poses a barrier to more traditional forms of health services utilization, thereby supporting previous research (Lethbridge-Cejku, Rose, and Vickerie 2006), it does not pose a barrier to going online for health-related purposes.

Finally, results suggest that e-mail may be a hybrid, driven not only by health status, as with conventional health system contact, but also by urban/rural location, as with Web site visits and online purchases. Like other forms of digital communication, e-mail requires access to an underlying telecommunications infrastructure. This infrastructure is better developed in urban/suburban than in rural areas. Unlike Web site visits, however, e-mail is also contingent on prior access to physicians and other health care professionals and may therefore be dependent, in part, on factors that drive conventional health system use (e.g., care-seeker health).

The Digital Divide and Consumer Usage

Closing inequities in HIT usage among consumers is key to reaping the cost savings, access, and quality improvements envisioned by policy makers and other advocates. Whereas 89.0 percent of college graduates use the Internet, for example, only 61.0 percent of high school graduates and 29.0 percent of those who did not graduate from high school do so (Fox 2005b). And even when access is available, members of underserved groups also face challenges evaluating the quality of the information posted. Not only is online health content often written at a reading level well exceeding that of many users, but it is also frequently found to be inaccurate, incomplete, or inconsistent (Eysenbach et al. 2002; Miller and West 2007). This is particularly salient given widespread documentation of racial and other class-based barriers to medical comprehension and clear links between poor health literacy and inadequate understanding of health and medical treatment (Mayer and Villaire 2004).

As telecommunications technology becomes further integrated into health services, disparities will be reinforced absent government intervention. Thus, several policy measures need to be undertaken in order to accelerate the appropriate use of digital technology by health care consumers. These include improving education and technological literacy and providing access to low-cost technology. Without a consumer complement to prevailing efforts to spur HIT development and implementation on the

part of providers, the promise of the digital revolution will continue to be limited.

Improving Education and Technological Literacy

Large segments of the population remain uninformed about digital technologies. This is reflected in a 2006 Pew survey that classified Americans into "elite tech" users (31 percent), "middle-of-the-road" users (20 percent), and users with "few tech assets" (49 percent) (Horrigan 2007). As long as such a broad swath of the general public remains detached from the "information superhighway," it will prove difficult to introduce electronic medical records, doctor-patient e-mail, and sophisticated health information Web sites on the scale envisioned by policy makers. Since technology utilization is highly correlated with education, boosting computer literacy and knowledge is critical to improving technology access and the use of digital medical resources.

Not all people feel equally comfortable searching for online information. This is reflected in the finding that unfamiliarity with digital technology was rated equally important to cost as a barrier to digital usage among women (Bowen et al. 2003). It is also reflected in the finding that difficulty evaluating the accuracy of online material is among the most frequently cited barriers preventing consumers from making greater use of electronic health resources (Anderson 2004). Many worry about losing the personal touch of health and medical providers if they rely on virtual contact instead of face-to-face visits (Miller 2003).

Privacy is a frequently cited concern. This is a particular worry in the e-health arena because of the sensitivity of health and medical data. If doctors and patients communicate electronically, for example, and online records detail a person's entire health and medical history, can consumers be guaranteed that this electronic information will be safe and secure (Hodge, Gostin, and Jacobson 1999)? Due, in part, to consumer concern, there has been growing adoption of privacy and security statements on government, commercial, and nonprofit Web sites in the health sector (Miller and West 2008; West and Miller 2006). This growth also reflects implementation of Title II of the Health Insurance Portability and Accountability Act (HIPAA) of 1996, which established privacy standards governing the use of patient information, in addition to security standards protecting the confidentiality, availability, and integrity of protected information. The quality of resulting privacy and security policies varies considerably, however; also, they do not apply to Web-based providers who

do not serve patients per se. Clearly, if citizens do not have confidence in digital technology or cannot evaluate the extent to which their personal information is safe and secure, they will be less likely to make use of electronic health resources.

In light of prevailing discomfort with digital technologies, it is important to offer training on how to search for information and evaluate its overall quality and security. The potential efficacy of this approach is reflected in one multicountry study, which found that as people became more technologically literate, they were able to understand why computers were helpful and were able to learn how to use digital resources to perform specific tasks (Veenhof, Clermont, and Sciadas 2005). Technical literacy is particularly important if it is to be viewed as an increasingly important component of health literacy in the digital age. Individuals with limited health literacy have less detailed information about diseases, are less likely to employ common kinds of preventive health measures, and experience poorer health (Institute of Medicine 2004). To the extent that policy makers view the Internet as a means of closing prevailing gaps in information access, concerns about health and technological literacy become inexorably intertwined.

One reason some groups are less likely to apply the Internet to health care is that educations received in underprivileged school districts tend to provide less instruction in the skills and attitudes necessary to access health information on the World Wide Web. Schools with greater minority enrollment are less likely to have a Web site or Web page, to allow students to use computers with Internet access before school, and to lend laptop computers to students (Parsad and Jones 2005). They also tend to have higher ratios of students to instructional computers. Differences in Internet instruction across school districts affect not only those who have received educations since the advent of the Internet age but also their parents and grandparents, since younger family members often represent the channel through which appreciation for new technologies is brought into the home (Fallows 2005).

Providing Access to Low-Cost Technology

Although computer ownership and broadband adoption has increased markedly over the last ten years, disparities persist across socioeconomic groups (Fox 2005b; Horrigan 2006; U.S. Census Bureau 2005; U.S. Department of Commerce 2004). Thus, for example, the percentage of college-educated adults with DSL or cable far exceeds the percentage of

high school graduates (62.0 vs. 31.0 percent) (Horrigan 2006). Furthermore, the percentage of adults with computers at home is far higher when household income exceeds $75,000 per year than when household income is under $25,000 annually (92.0 vs. 42.0 percent) (U.S. Census Bureau 2005). Cost is the reason consumers most frequently cite for not accessing the Internet (Bowen et al. 2003; Horrigan 2006; U.S. Department of Commerce 2004). When asked to identify the main reason for not using the Internet at home or for discontinuing service if it had existed previously, the majority indicate that it was too expensive or that no computer or only an inadequate computer was available (U.S. Department of Commerce 2004).

Current trends in use of the Internet as a source of health care information and transaction suggest that unless the issue of cost is addressed, the outcome will be a two-tiered system in which select groups of consumers are able to use digital technologies as a complement to or substitute for conventional health system contact. In 1995, then–Speaker of the U.S. House of Representatives Newt Gingrich suggested giving tax credits to poor families who purchased laptop computers (Ratnesar 1998). Soon thereafter, school districts around the country began to loan students laptops, though just 8 percent of school districts did so in 2003; most loans lasted one week or less, and relatively few districts allowed students to keep laptops for the entire school year (Parsad and Jones 2005). Some nonprofit organizations have worked to develop low-cost technology that would facilitate digital access. This is reflected in the One Laptop Per Child Foundation, which offers new laptops for $350 that are designed for people living in impoverished regions (Finkle 2007). Though early reviews of the XO laptops were quite positive, orders lagged behind expectations because the price for these machines continued to exceed what people in developing nations were willing to pay (Lohr 2007).

In the United States, the Veterans Health Administration (VHA) has had considerable success in using telecommunications technology to connect VHA providers to needy veterans, including elderly individuals, who are much less likely to own a computer or have broadband access, let alone use the Internet (Fox 2005b; Horrigan 2006; U.S. Census Bureau 2005). Perhaps this is best illustrated by the VHA's care coordination efforts, which use various tele-health devices to promote self-management, education, and monitoring of veterans with chronic disease, typically at little or no cost to the veterans themselves (Joseph 2006). Technologies range from stand-alone monitoring, messaging, and measurement systems to personal

computers, videophones, and computer-assisted telephone screens (U.S. Department of Veterans Affairs 2004).

There is no doubt that barriers to consumer usage will be difficult to overcome in regions of the country that lack the infrastructure and resources necessary to sustain HIT use and development. Just as providers cannot read X-rays or transfer EMRs without high-speed communication networks, slow-speed connections frustrate consumers, precluding many from going online for their health and medical needs. In countries where there has been a substantial leap forward on e-health, broadband investment has been a major factor. In the nineteenth and twentieth centuries, governments invested large sums of money in railroads, canals, highways, and airports. These infrastructure investments spurred economic development and allowed businesses to travel easily and communicate with customers and other companies. Without significant government investment and leadership, broadband access will grow more slowly than it would otherwise, with no or limited service in traditionally underserved regions of the country.

Governments in Asia and Europe have taken on the role of building the information technology infrastructure, but the United States has lagged behind. Here the government has left the implementation of broadband development to the private sector. The result has been a patchwork of Internet connections that inhibits communications and makes it difficult to build reliable networks over broad geographical areas. Indeed, it is difficult to understate the importance of government leadership and coordination. It is one reason that countries with more centralized health systems have been far more successful than the United States in adopting interoperable hardware and software (Shortliffe 2005). It is also the reason that the VHA has been far more successful than the United States more generally in adopting HIT.

To help fill existing gaps and bypass the large telecom companies, localities around the country have increasingly sought to install their own Wi-Fi networks to "leapfrog" the hardware infrastructure (DiPasquale 2007). In so doing, government officials hope that wireless connections will allow underserved populations to gain access to the Internet at lower prices and thereby reap the advantages of information technology. These efforts have been slow to get off the ground, however, having been stymied by financial difficulties, security concerns, and resistance on the part of the telephone and cable providers and their allies in the state legislatures.

If public officials want electronic health to flourish, they must provide the budget and build the political coalitions necessary for technology investment. More widespread use of the health care Internet will require high-speed communications networks, and governments play a crucial role in building this technology infrastructure. Without government leadership, digital medicine will generate neither desired service improvements nor anticipated cost savings.

Conclusion

The present study breaks new ground by using a national survey of adults to examine the degree to which health care consumers in the United States engage in conventional in-person consultation and telephone calls, e-mail contact, Web site visits, and online purchases. Despite the contributions of our research, it has several limitations worth noting. First, results derive from self-reports rather than actual observation of behaviors. Not only do we have no way of determining the accuracy of responses, but responses could also be affected by recall bias or the tendency of survey respondents to provide socially desirable answers (Presser et al. 2004). Second, our response rate could be improved through the use of more callbacks and a longer survey period. Third, in order to promote responses, we kept the number of questions to a minimum, thereby reducing the pool of potential covariates to include in our statistical analyses. Limited survey length also raises the specter of omitted variable bias, which is particularly salient where provider characteristics are concerned: for example, patients can e-mail providers only if providers choose to communicate that way first. Future surveys should incorporate respondent knowledge of provider-level factors. Finally, although causality is much more easily attributed in longitudinal studies, we relied exclusively on cross-sectional data. As in any cross-sectional survey, the associations reported in this article may not be indicative of causality.

Policy makers are beginning to target health care as an area where information technology can improve service delivery, promote efficiency, educate consumers, and increase satisfaction with medical care. However, the relatively low utilization levels identified, along with inequities based on age, gender, education, income, and residence, suggest the need for further reform. Since our results indicate that respondents engaged in one form of digital communication behavior (typically Web site visits) are more likely to engage in others (e-mail or online purchase), promot-

ing health-related Internet use in one area should have positive spillover effects for utilization of the health care Internet more generally. Encouragement should include education and training, infrastructure development, and financial assistance. Although programs directed at facilitating use need to be targeted at consumers, they must continue to be targeted at providers as well, not only as a means of encouraging greater use of HIT in their own practices, which has been relatively slow to date, but also as a means of helping patients make the most appropriate use of the digital materials that are available.

References

Andersen, R. 1995. Revisiting the Behavior Model and Access to Care: Does It Matter? *Journal of Health and Social Behavior* 36: 1–10.

Anderson, G. F., B. K. Frogner, R. A. Johns, and U. E. Reinhardt. 2006. Health Care Spending and Use of Information Technology in OECD Countries. *Health Affairs* 25: 819–831.

Anderson, J. 2004. Consumers of e-Health: Patterns of Use and Barriers. *Social Science Computer Review* 22: 242–248.

Audet, A. M., M. Doty, J. Peugh, J. Shamasdin, K. Zapert, and S. Schoenbaum. 2004. Information Technologies: When Will They Make It into Physicians' Black Bags? *Medscape General Medicine* 6 (5): 2.

Baker, L., T. H. Wagner, S. Singer, and M. K. Bundorf. 2003. Use of the Internet and E-mail for Health Care Information. *Journal of the American Medical Association* 289: 2400–2406.

Battaglia, M. P., D. C. Hoaglin, D. Izrael, M. Khare, and A. Mokdad. 2002. Improving Income Imputation by Using Partial Income Information and Ecological Variables. *Joint Statistics Meetings—Section on Survey Research Methods*. New York: Joint Statistical Meetings.

Blumenthol, D. 2002. Doctors in a Wired World: Can Professionalism Survive Connectivity? *Milbank Quarterly* 80: 525–546.

Bowen, D., H. Meishke, N. Bush, J. Wooldridge, R. Robbins, A. Ludwig, and G. Escamilla. 2003. Predictors of Women's Internet Access and Internet Health Seeking. *Health Care for Women International* 24: 940–951.

Brodie, M., R. E. Flournoy, D. E. Altman, R. J. Blendon, J. M. Benson, and M. D. Rosenbaum. 2000. Health Information, the Internet, and the Digital Divide. *Health Affairs* 19 (6): 255–265.

Chew, L. D., K. A. Bradley, and E. J. Boyko. 2004. Brief Questions to Identify Patients with Inadequate Health Literacy. *Family Medicine* 36: 588–594.

Clinton, H. 2008. *Providing Affordable and Accessible Health Care*. www.hillaryclinton.com/issues/healthcare/summary.aspx (accessed March 22, 2008).

Diaz, J. A., R. A. Griffith, J. J. Ng, S. E. Reinert, P. D. Friedman, and A. W. Moulton. 2002. Patients' Use of the Internet for Medical Information. *Journal of General Internal Medicine* 17 (3): 180–185.

Dickerson, S., A. E. Reinhart, T. H. Feeley, R. Bidani, E. Rich, V. K. Garg, and C. O. Hersey. 2004. Patient Internet Use for Health Information at Three Urban Primary Care Clinics. *Journal of the American Medical Informatics Association* 11: 499–504.

DiPasquale, J. 2007. *Cities Providing Wi-Fi to Residents—Broadband Socialism or Wireless Freedom*. tlp.law.pitt.edu/SP_DiPasquale_ BroadbandSocialism.htm (accessed March 25, 2008).

Eysenbach, G., J. Powell, O. Kuss, and E.-R. Sa. 2002. Empirical Studies Assessing the Quality of Health Information for Consumers on the World Wide Web. *Journal of the American Medical Association* 287: 2691–2700.

Fallows, D. 2005. *How Women and Men Use the Internet*. Washington, DC: PEW Internet and American Life Project.

Finkle, J. 2007. Nonprofit May Launch $350 Laptop by Christmas. *Boston Globe*, July 23.

Fox, S. 2005a. *Health Information Online: Eight in Ten Internet Users Have Looked for Health Information Online*. Washington, DC: PEW Internet and American Life Project.

———. 2005b. *Digital Divisions: There Are Clear Differences among Those with Broadband Connections, Dial-Up Connections, and No Connections at All to the Internet*. Washington, DC: PEW Internet and American Life Project.

Fox, S., and D. Fallows. 2003. *Internet Health Resources: Health Searches and Email Have Become Commonplace, but There Is Room for Improvement in Searches and Overall Internet Access*. Washington, DC: PEW Internet and American Life Project.

Garber, K. M. 2006. *The U.S. Health Care Delivery System: Fundamental Facts, Definitions, and Statistics*. Chicago: American Hospital Association Press.

Gingrich, N., D. Pavey, and A. Woodbury. 2003. *Saving Lives and Saving Money: Transforming Health and Healthcare*. Washington, DC: Alexis de Tocqueville Institution.

Grant, M., G. Marshall, and R. Hays. 1994. *The Patient Satisfaction Questionnaire Short Form (PSQ-18)*. Santa Monica, CA: RAND Corporation.

Hall, J. A., D. L. Roter, and N. R. Katz. 1988. Meta-Analysis of Correlates Provider Behavior in Medical Encounters. *Medical Care* 26: 657–675.

Hillestad, R., J. Bigelow, A. Bower, F. Girosi, R. Meili, R. Scoville, and R. Taylor. 2005. Can Electronic Medical Record Systems Transform Health Care? Potential Health Benefits, Savings, and Costs. *Health Affairs* 24: 1103–1117.

Himmelstein, D. U., and S. Woolhandler. 2005. Hope and Hype: Predicting the Impact of Electronic Medical Records. *Health Affairs* 25: 1121–1123.

Hodge, J. G., L. O. Gostin, and P. D. Jacobson. 1999. Legal Issues Concerning Electronic Health Information. *Journal of the American Medical Association* 282: 1466–1471.

Horrigan, J. 2006. *Home Broadband Adoption 2006*. Washington, DC: Pew Internet and American Life Project.

———. 2007. *A Typology of Information and Communication Technology Users*. Washington, DC: Pew Internet and American Life Project.

Institute of Medicine. 2004. *Health Literacy: A Prescription to End Confusion*. Washington, DC: National Academies Press.

Jordan, K., B. N. Ong, and P. Croft. 2003. Previous Consultation and Self Reported Health Status as Predictors of Future Demand for Primary Care. *Journal of Epidemiology and Community Health* 57 (2): 109–113.

Joseph, A. M. 2006. Care Coordination and Telehealth Technology in Promoting Self-Management among Chronically Ill Patients. *Telemedicine Journal and E-Health* 12 (2): 156–159.

Kleinke, J. D. 2005. Dot-gov: Market Failure and the Creation of a National Health Information Technology System. *Health Affairs* 24: 1246–1262.

Lethbridge-Cejku, M., D. Rose, and J. Vickerie. 2006. Summary Health Statistics for U.S. Adults: National Health Interview Survey, 2004. *Vital and Health Statistics*. Series 10, no. 228. Hyattsville, MD: National Centers for Health Statistics.

Lin, C. T., L. Wittevrongel, L. Moore, and B. Beaty. 2005. An Internet-Based Patient-Provider Communication System: Randomized Controlled Trial. *Journal of Medical Internet Research* 7 (4): e47.

Lohr, S. 2007. Buy a Laptop for a Child, Get Another Laptop Free. *New York Times*, September 24.

Mayer, G., and M. Villaire. 2004. Low Health Literacy and Its Effects on Patient Care. *Journal of Nursing Administration* 34: 400–442.

Middleton, B. 2005. Achieving U.S. Health Information Technology Adoption: The Need for a Third Hand. *Health Affairs* 24: 1269–1272.

Miller, E. A. 2003. The Technical and Interpersonal Aspects of Telemedicine: Effects on Doctor-Patient Communication. *Journal of Telemedicine and Telecare* 9 (1): 1–7.

———. 2007. Solving the Disjuncture between Research and Practice: Telehealth Trends in the 21st Century. *Health Policy* 82: 133–141.

Miller, E. A., and D. M. West. 2007. Characteristics Associated with Use of Public and Private Sector Websites as Sources of Health Care Information: Results from a National Survey. *Medical Care* 45: 245–251.

———. 2008. *Comparing Health Content on Government, Commercial, and Non-Profit Websites*. Providence, RI: Brown University. Prepared for the Annual Meeting of the Midwest Political Science Association, Chicago, April 3–6.

Miller, E. A., D. M. West, and M. Wasserman. 2007. Health Information Websites: Characteristics of US Users by Race and Ethnicity. *Journal of Telemedicine and Telecare* 13 (6): 298–302.

Miller, R. H., and I. Sim. 2004. Physicians' Use of Electronic Medical Records: Barriers and Solutions. *Health Affairs* 23 (2): 116–126.

Misra, D. 2001. *Women's Health Data Book: A Profile of Women's Health in the United States*. 3rd ed. Washington, DC: Jacobs Institute of Women's Health.

Parsad, B., and J. Jones. 2005. *Internet Access in U.S. Public Schools and Classrooms:*

1994–2003 (NCES 2005–015). Washington, DC: National Center for Education Statistics.

Presser, S., J. M. Rothgeb, M. P. Couper, J. T. Lessler, E. Martin, J. Martin, and E. Singer. 2004. *Methods for Testing and Evaluating Survey Questionnaires*. Hoboken, NJ: Wiley.

Raghunathan, T. E. 2004. What Do We Do with Missing Data? Some Options for Analysis of Incomplete Data. *Annual Review of Public Health* 25: 99–117.

Ratnesar, R. 1998. Learning by Laptop. *Time*, March 2. www.time.com/time/printout/0,8816,987892,00.html.

Rice, R. E. 2006. Influences, Usage, and Outcomes of Internet Health Information Searching: Multivariate Results from the PEW Surveys. *Journal of the American Medical Informatics Association* 75 (1): 8–28.

Rutland, J., C. Marie, and B. Rutland. 2004. A System of Telephone and Secure Email Consultations, with Automatic Billing. *Journal of Telemedicine and Telecare* 10 (Supp. 1): S1:88–S1:91.

Shortliffe, E. 2005. Strategic Action in Health Information Technology: Why the Obvious Has Taken So Long. *Health Affairs* 24: 1222–1233.

U.S. Census Bureau. 2005. *Computer and Internet Use in the United States: 2003*. Washington, DC: U.S. Census Bureau, U.S. Department of Commerce.

U.S. Department of Commerce. 2004. *A National Online: Entering the Broadband Age*. Washington, DC: U.S. Department of Commerce.

U.S. Department of Veterans Affairs. 2004. *Office of Care Coordination Technology Assignment Algorithm*. www.va.gov/occ/natl_rollout/Technology_ Assignment _Algorithm.pdf (accessed March 25, 2008).

U.S. General Accountability Office. 2005. *Health Information Technology: HHS Is Taking Steps to Develop a National Strategy*. 05–628. Washington, DC: U.S. General Accountability Office.

Veenhof, B., Y. Clermont, and G. Sciadas. 2005. *Literacy and Digital Technologies*. Ottawa, Ontario: Statistics Canada.

West, D. M. 2005. *Digital Government: Technology and Public Sector Performance*. Princeton, NJ: Princeton University Press.

West, D. M., and E. A. Miller. 2006. The Digital Divide in Public E-Health: Barriers to Accessibility and Privacy in State Health Department Websites. *Journal of Health Care for the Poor and Underserved* 17: 652–667.

White House. 2004. *Executive Order: Incentives for the Use of Health Information Technology*. April 27. www.whitehouse.gov (accessed February 7, 2006).

Ybarra, M. L., and M. Suman. 2006. Help Seeking Behavior and the Internet: A National Survey. *Journal of the American Medical Informatics Association* 75 (1): 29–41.