Is There a Digital Divide among Physicians? A Geographic Analysis of Information Technology in Southern California Physician Offices

DOUGLAS S. BELL, MD, PHD, DIANNA M. DALY, MSPH, PAUL ROBINSON, PHD

Abstract

Objective: The aim of this study was to determine whether physician offices located in high-minority and low-income neighborhoods have different levels of access to information technology than offices located in lower-minority and higher-income areas.

Design: A cross-sectional survey was conducted of pediatrics, family medicine, and general practice offices in Orange County, California. Survey data were linked with community demographic data from the 2000 Census using a geographical information system.

Results: Of 307 offices surveyed, 141 responded (46%). Offices located in high-minority and high-poverty areas were as likely to respond as other offices. Among responding offices, 94% had a computer, 77% had Web access, 29% had broadband Internet access, and 53% used computerized scheduling and billing systems. Offices located in minority and low-income communities had equivalent access to each technology. Offices in communities with larger proportions of Hispanics were less likely to have practice Web pages, but other uses of the Internet were not associated with practice location. Offices reported high levels of interest in online clinical systems but also high levels of concern about these systems’ usability and confidentiality. Offices with Web access and those with practice management systems expressed greater interest in online clinical systems but also greater levels of concern about usability and confidentiality. These attitudes were equivalent among offices in different communities.

Conclusion: Primary care offices located in poor and minority communities in a large, suburban county had high levels of access to and interest in Web-based systems. Physicians’ offices may therefore provide a venue for online services aimed at improving health outcomes for poor and minority communities. Research is needed in other geographic regions to determine the generalizability of these findings.


Several minority groups in the United States have worse health than the overall U.S. population, and these disparities cannot be explained by biological differences. Hispanics, for example, have higher rates of high blood pressure and obesity than non-Hispanic whites, and they are twice as likely to die of diabetes mellitus. Studies have also found that disadvantaged minority groups are less likely to receive necessary procedures when they are indicated. Persons living in areas of greater poverty also receive less adequate medical care and have worse health outcomes. Online services may help patients improve their health by supporting their self-care activities directly and by improving their communications with health care providers. Access to online services is more limited, however, among disadvantaged segments of the U.S. population, a disparity referred to as the digital divide. The September 2001 U.S. Current Population Survey found that 60% of whites and Asian/Pacific Islanders were users of the Internet from at least one location; however, for blacks and Hispanics these proportions were 39% and 32%, respectively. For Hispanics who live in households in which Spanish is the only language spoken, the proportion using the Internet was 14%. To the extent that Internet services play a role in patients' health, the digital divide could result in greater health benefits for the less-disadvantaged populations that have Internet access, thus, potentially widening the health disparities that exist today. Although some online services have targeted disadvantaged patient populations, significant additional

Affiliations of the authors: Division of General Internal Medicine and Health Services Research, Department of Medicine, David Geffen School of Medicine at UCLA, Los Angeles, California (DSB); RCMI Minority Research Center, Charles R. Drew University School of Medicine, Los Angeles, California (DSB, PR); CalOptima, Orange, California (DMD); Department of Geography, California State University, Northridge, California (PR).

Supported in part by CalOptima Health System, by the National Center for Research Resources, grant G12 RR 03026-13, by the Robert Wood Johnson Foundation Generalist Faculty Physician Scholars Program, and by the Mary and Irving Lazar Program in Health Services Research at UCLA. The authors thank Dr. Mark Granoff for facilitating their relationship with CalOptima, Dr. Noam H. Artz of HLN Consulting, LLP, for supervising conduct of the survey, and Dr. Carol Mangione for helpful discussions and comments on the manuscript.

Correspondence and reprints: Douglas S. Bell, MD, PhD, UCLA Division of General Internal Medicine and Health Services Research, 911 Broxton Plaza, Room 314, Los Angeles, CA 90095-1736; e-mail: <dbell@ucla.edu>.

Received for publication: 01/31/03; accepted for publication: 03/31/03.
investments would likely be needed to bring these populations online. Online services targeted to health care providers may also improve patient health by improving the quality of care providers are capable of delivering. Several online initiatives have specifically targeted rural physicians, and users of one such initiative perceived that it helped them to avoid adverse events. Surveys of nationally representative physician samples have shown that physicians’ current use of the World Wide Web increased from 37% in 1999 to 70% in 2000 and to 78% at the end of 2001. In the most recent of these surveys, access was not strongly related to physicians’ age—65% of physicians aged 60 years or older were Web users. Thus, although most physicians are frequent users of the Web, perhaps one fifth remain nonusers, and the penetration among this group may be slowing.

It is not known whether physicians who practice in disadvantaged communities can access the Internet to the same extent as their peers. The structural factors that prevent physicians from delivering the highest-quality care in these communities may also reduce their opportunities for Internet access. If there is a digital divide among physicians, and if online systems for physicians prove highly effective for improving patients’ health, then these systems might worsen socioeconomic health disparities unless companion efforts are undertaken to ensure equal access. However, if physicians in disadvantaged communities already have equitable Internet access, then they may be ready for online initiatives aimed specifically at reducing health disparities.

This study used a survey of physicians’ offices in Orange County, California, to test the hypothesis that those offices located in areas with larger poor and minority populations have less access to online resources than offices located in wealthier, predominantly white neighborhoods. We also sought to compare attitudes toward online systems among offices in these different neighborhood locations. Orange County’s minority populations include large numbers of Hispanic persons and also a large group of Vietnamese immigrants, many of whom lack health insurance and are medically underserved. The county also includes neighborhoods with concentrated poverty, but it lacks a substantial black population.

Methods
Survey Development
CalOptima, the county-organized health system that administers Medicaid for Orange County, California, conducted a survey to assess the readiness of physicians’ offices to participate in an online childhood immunization registry. CalOptima serves approximately 150,000 members under age 21, and about 80% of pediatric primary care providers in Orange County participate in its programs. Survey questions assessing offices’ needs for, attitudes toward, and technology available for online patient tracking were drafted by HLN Consulting, a firm with experience advising community physicians’ offices on information technology. The draft survey was refined based on feedback from local representatives of the American Academy of Pediatrics and the Orange County Health Care Agency and from two focus groups. To improve the survey’s focus on barriers to immunization tracking, a presentation and facilitated discussion was held with 29 members of the Orange County Immunization Coalition, a group that represents more than 40 local organizations committed to improving the immunization rates of Orange County children. To further tailor the questions for Orange County practices, a second focus group was held with 14 physicians, nurses, and office managers from a range of both small and large practices in Orange County. The Appendix shows the final survey, which was designed to be completed by a physician-manager, a nurse-manager, or an office manager, in consultation with other office staff, as appropriate. In answering questions about the technology being used in the office, respondents were instructed to consult with any information technology staff. However, for many offices, information technology is managed by a knowledgeable individual in the office or by an outside consultant, rather than by any dedicated staff.

Data Collection
The final survey was mailed in March 2001 to all physicians’ offices in Orange County that contract with CalOptima for the primary care of pediatric patients, including family and general practitioners as well as pediatricians. Practices that had participated in the final focus group to develop the survey were included. Responses could be submitted by returning the paper form by mail or by fax or by filling out the form online. Respondents were offered their choice of a $25 office-supply gift certificate or a gourmet dessert gift basket. In addition, online respondents were entered into a drawing for a $1,000 office-supply gift certificate. A reminder postcard was sent ten days after the initial survey mailing. Each office that had not responded by two weeks after the initial mailing was telephoned. An additional copy of the survey was faxed to offices if, during the telephone call, staff in the nonresponding office could not readily find the original survey. Offices that had not responded after an additional week were called a second time.

Analysis
Using 2000 Census data, the 577 census tracts in Orange County, California, were categorized based on the ethnicity, race, and income of their residents. For each characteristic, four ordinal categories were used. Thus, for example, each tract was assigned to Hispanic category 1, 2, 3, or 4, where category 1 contains the tracts having the lowest proportion of Hispanic residents, and category 4 contains the tracts having the highest proportion of Hispanic residents. The category boundaries were determined using an iterative application of the goodness of variance fit (GVF) method for minimizing variance within classes. This procedure, also known as Jenks optimization, determines the class groupings that produce optimally homogeneous groups, based on the number of classes chosen. Thus, each of the four Hispanic population categories has the minimum possible within-class variance and the maximum distance between classes. We chose to use four levels because this number of categories provided an adequate chance of detecting a trend while keeping the tracts within each category relatively contiguous geographically. Census tracts are designed to contain approximately 5,000 residents, and they represent smaller areas than postal zip codes.

Because Orange County has only a small black/African-American population, census tracts were not classified based
on the percent black. However, Orange County has a large population of Vietnamese immigrants, many of whom lack health insurance and are medically underserved.23,24 Census tracts were therefore categorized based on the proportion of nonwhite residents (defined as the sum of black, Asian, American Indian, Hawaiian/Pacific Islander, other, and mixed-race residents), using the GVF algorithm. Finally, the same method was used to classify census tracts based on the proportion of households having a median income below the federal poverty level.

The Census tract location of each office surveyed (both respondents and nonrespondents) was determined by geocoding based on the office’s address. First, the geographic coordinates of offices were determined using the geocode function of the ArcView geographical information system (GIS) software (ESRI, Redlands, CA). Addresses that did not automatically match during batch processing with ArcView were geocoded manually using detailed paper street maps. The GIS software then was used to link the coordinate location of each surveyed office to the Census tract in which the office was located.

Attitudinal scales were constructed using the following procedure, which has been termed multitrait scaling analysis.26 Each attitudinal item was hypothesized to assess one of the following coherent scales: offices’ difficulty tracking patient information, their interest in having online clinical systems, and their concerns about online clinical systems. Each respondent’s score for each scale was calculated as the mean response among hypothesized items. To ease human interpretation, the scales were adjusted to range from 1 to 10 by multiplying the mean item response, which ranged from 1 to 4, by a factor of 2.5. Scale scores were considered missing if more than half of their component items were unanswered. To look for items that did not fit with the hypothesized scale or that might better fit with a different scale, we examined correlation coefficients for each individual item compared with each of the three hypothesized scales. Those that correlated poorly with any of the scales were to be considered for exclusion, and those that correlated with a scale other than the hypothesized one were to be considered for inclusion in that alternative scale, depending on the item content.

Statistical tests of association for contingency tables were the χ² test and, where expected cell counts were low, Fisher’s exact test. We used the Cochran-Armitage test for trends in binomial proportions across levels of ordinal categories27,28 and the Wilcoxon rank-sum test for differences in scale scores among groups.29 Internal consistency of scales was calculated using Cronbach’s alpha.30 Statistical calculations were carried out in SAS, version 8 (SAS Institute, Cary, NC).

Results

In the 2000 Census, Orange County’s 2.8 million residents had a racial composition of 65% white, 14% Asian, 2% black, 0.7% American Indian, 0.3% Hawaiian/Pacific Islander, 15% other race, and 4% mixed-race. Their ethnic composition was 31% Hispanic and 69% non-Hispanic. Their median household income was $58,820, per capita income was $25,826, and their overall poverty rate was 10.3%. In comparison, the 2000 Census found that the overall U.S. population was 75.1% white, 4% Asian, 12% black, 0.9% American Indian, 0.1% Hawaiian/Pacific Islander, and 5.5% other race. Hispanic ethnicity was 13% nationally. The national median household income was $41,994, per capita income was $21,587, and the poverty rate was 12.4%. Thus, Orange County is somewhat wealthier than the nation as a whole, it has Hispanic and Asian persons significantly overrepresented, and it has black persons significantly underrepresented.

The GVF analysis of the Hispanic population densities among census tracts resulted in census tract–category boundaries at 19.4%, 39.7%, and 67% (Table 1). As a result, the two lower-Hispanic groups included census tracts having 0–19.3% and 19.4–39.6% Hispanic residents, and the two higher-Hispanic groups included tracts having 39.7–65.4% and 67.9–97.5%

Table 1 ■ Characteristics of Census Tracts in Orange County, California, Grouped by Percent Minority and Poverty Status Using a Clustering Algorithm

<table>
<thead>
<tr>
<th>Category</th>
<th>Number of Tracts</th>
<th>Total Population</th>
<th>Total Land Area (mile²)</th>
<th>Population Density</th>
<th>Per-capita Income (US $)</th>
<th>Offices Surveyed*</th>
<th>Offices per 10,000 Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hispanic</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 (0–19%)</td>
<td>316</td>
<td>1,391,926</td>
<td>606</td>
<td>5,666</td>
<td>36,762</td>
<td>89</td>
<td>0.64</td>
</tr>
<tr>
<td>2 (19–40%)</td>
<td>122</td>
<td>618,096</td>
<td>88</td>
<td>8,483</td>
<td>20,324</td>
<td>98</td>
<td>1.59</td>
</tr>
<tr>
<td>3 (40–65%)</td>
<td>78</td>
<td>440,651</td>
<td>61</td>
<td>10,743</td>
<td>15,649</td>
<td>60</td>
<td>1.36</td>
</tr>
<tr>
<td>4 (68–98%)</td>
<td>61</td>
<td>395,616</td>
<td>35</td>
<td>17,061</td>
<td>10,564</td>
<td>60</td>
<td>1.52</td>
</tr>
<tr>
<td>Nonwhite</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 (2–18%)</td>
<td>148</td>
<td>602,012</td>
<td>361</td>
<td>5,148</td>
<td>41,719</td>
<td>18</td>
<td>0.30</td>
</tr>
<tr>
<td>2 (18–32%)</td>
<td>163</td>
<td>779,426</td>
<td>192</td>
<td>6,300</td>
<td>31,213</td>
<td>65</td>
<td>0.83</td>
</tr>
<tr>
<td>3 (32–50%)</td>
<td>143</td>
<td>718,551</td>
<td>155</td>
<td>8,401</td>
<td>21,185</td>
<td>91</td>
<td>1.27</td>
</tr>
<tr>
<td>4 (51–99%)</td>
<td>123</td>
<td>746,300</td>
<td>83</td>
<td>13,934</td>
<td>13,574</td>
<td>133</td>
<td>1.78</td>
</tr>
<tr>
<td>Percent below poverty</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 (0–6%)</td>
<td>283</td>
<td>1,226,029</td>
<td>593</td>
<td>5,422</td>
<td>36,689</td>
<td>76</td>
<td>0.62</td>
</tr>
<tr>
<td>2 (6–13%)</td>
<td>143</td>
<td>715,577</td>
<td>101</td>
<td>8,135</td>
<td>24,382</td>
<td>100</td>
<td>1.40</td>
</tr>
<tr>
<td>3 (13–23%)</td>
<td>114</td>
<td>660,412</td>
<td>75</td>
<td>11,777</td>
<td>14,928</td>
<td>101</td>
<td>1.53</td>
</tr>
<tr>
<td>4 (24–68%)</td>
<td>37</td>
<td>244,471</td>
<td>22</td>
<td>17,943</td>
<td>10,540</td>
<td>30</td>
<td>1.23</td>
</tr>
</tbody>
</table>

NOTE. Orange County's 577 Census tracts were categorized according to the percent Hispanic, the percent nonwhite, and the percent below poverty in each tract, using a goodness of variance fit method to set category boundaries that minimize within-category variance. Categories are arranged from lowest (1) to highest (4), with the lowest and highest values in the category shown in parentheses. Data are from the 2000 Census. *Number of offices that contract for the care of children with CalOptima, the MediCal health plan for Orange County, California.
Hispanic residents. Geographically, the higher-Hispanic tracts were clustered in north-central areas of the county (Fig. 1a). The GVF algorithm produced boundaries for nonwhite categories at 18.0%, 32.3%, and 50.5%, and boundaries for poverty categories at 6.3%, 13.1%, and 23.6%. The geographic distributions of the higher-nonwhite and the higher-poverty categories also show significant clustering in areas that partially overlap with the higher-Hispanic areas (Fig. 1a through c; Fig. 1b and 1c are located in an online data supplement at www.jamia.org). Table 1 shows that the higher-Hispanic, higher-nonwhite, and greater-poverty areas had markedly greater population densities and lower per-capita incomes ($p < 0.0001$ for each correlation).

The 307 Orange County physicians’ offices surveyed were located in 168 of the census tracts. Table 1 shows that substantial numbers of offices were located in the higher-Hispanic, higher-nonwhite, and higher-poverty areas. Of the 307 offices, 141 offices completed the survey (a 46% response rate). Among the responding offices, 72 (51%) returned the survey without any telephone call, 52 (37%) returned the survey after one phone call, and 17 (12%) returned the survey after two calls. The survey was completed online by 38 offices (27%), with the remainder completing the paper survey and returning it by mail (56 offices, 40%) or by fax (47 offices, 33%). Among the 166 offices that did not complete the survey, all but three were reached at least once by telephone. Table 2 compares the characteristics of responding offices with those of nonresponding offices. General practitioners and offices having one to two physicians were slightly less likely to respond than were pediatricians and larger offices. However, Cochran-Armitage tests showed no trends in response rate by office location.

The questions on information technology available in the office were answered by 140 of the 141 responding offices. Of these, 132 (94%) had at least one computer in the office, 108 (77%) had Web access in the office, and 40 (29%) had

![Figure 1a. Geographic distribution of Hispanic residents and physician offices in Orange County, California. Tracts from the 2000 Census are shaded according to the categories shown in Table 1, with the darkest shades representing the highest-numbered categories. The location of each physician office surveyed is shown as a point on the map. Figures 1b and 1c are online data supplements at www.jamia.org.](image_url)
broadband Internet access (cable modem, DSL, T1, or higher-speed connection in the office). Table 3 shows that offices located in areas with greater minority populations and higher poverty had computers, Web access, and broadband Internet access as frequently as offices in predominantly white and wealthy areas. Cochran-Armitage tests showed no trends in Web access by office location. Among the 140 responding offices, the following specific uses of the Internet were reported: online shopping (23%), insurance eligibility checking (33%), authorization requests (21%), claims submission (24%), patient management/contact (16%), research (42%), and maintaining a practice Web page (21%). As shown in Table 3, the Cochran-Armitage test results showed significantly lower use of practice Web pages among offices in more-heavily Hispanic neighborhoods. However, none of the other Internet uses were associated with office location.

Among the 108 offices with Web access, 68% reported Web use by physicians, 69% reported Web use by clinical staff, and 86% reported Web use by administrative/clerical staff. Sixty-one percent of offices had Web-capable computers at the front desk, 57% had them in physicians’ personal offices, and 25% had them in other locations, primarily in administrators’ offices. None of the offices had Web-capable computers in examination rooms. Cochran-Armitage tests found no associations of these characteristics with offices’ geographic locations.

A computerized practice management system was in use at 69 offices (53% of the 129 offices providing data for this item). The offices named 24 specific practice management systems in use, the most common being MediSoft (used by 15), and CompuMedic (used by 4). Offices without Web access were less likely to use a computerized practice management system (29% vs. 60% for offices with Web access, $p = 0.003$). The use of a practice management system also showed no association with office location.

The survey’s attitudinal questions formed three highly coherent scales. The DIFFICULTY scale, which consisted of seven items assessing the office’s difficulties in tracking different kinds of patient information, had a Cronbach’s alpha of 0.93. The INTEREST scale, which consisted of 22 items assessing the office’s interest in a variety of potential online tracking systems, had a Cronbach’s alpha of 0.96. The CONCERNS scale, which consisted of eight items assessing the office’s

### Table 2 • Characteristics of Responding and Nonresponding Physicians’ Offices

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Respondents (n = 141)</th>
<th>Nonrespondents (n = 166)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specialty*</td>
<td>n %</td>
<td>n %</td>
<td></td>
</tr>
<tr>
<td>Family practice</td>
<td>58 41</td>
<td>72 43</td>
<td>0.04‡</td>
</tr>
<tr>
<td>General practice</td>
<td>32 23</td>
<td>54 33</td>
<td></td>
</tr>
<tr>
<td>Pediatrics</td>
<td>51 36</td>
<td>40 24</td>
<td></td>
</tr>
<tr>
<td>Providers in office†</td>
<td>116 82</td>
<td>153 92</td>
<td>0.02§</td>
</tr>
<tr>
<td>1–2</td>
<td>4 3</td>
<td>3 1</td>
<td></td>
</tr>
<tr>
<td>3–9</td>
<td>21 15</td>
<td>10 6</td>
<td></td>
</tr>
<tr>
<td>10 or more</td>
<td>58 41</td>
<td>74 43</td>
<td></td>
</tr>
<tr>
<td>Office location</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hispanic category</td>
<td></td>
<td></td>
<td>0.21</td>
</tr>
<tr>
<td>1 (0–19%)</td>
<td>35 33</td>
<td>54 25</td>
<td></td>
</tr>
<tr>
<td>2 (19–40%)</td>
<td>50 29</td>
<td>48 36</td>
<td></td>
</tr>
<tr>
<td>3 (40–65%)</td>
<td>23 22</td>
<td>37 16</td>
<td></td>
</tr>
<tr>
<td>4 (68–98%)</td>
<td>33 16</td>
<td>27 23</td>
<td></td>
</tr>
<tr>
<td>Nonwhite category</td>
<td></td>
<td></td>
<td>0.85</td>
</tr>
<tr>
<td>1 (2–18%)</td>
<td>7 5</td>
<td>11 7</td>
<td></td>
</tr>
<tr>
<td>2 (18–32%)</td>
<td>31 22</td>
<td>34 20</td>
<td></td>
</tr>
<tr>
<td>3 (32–50%)</td>
<td>45 32</td>
<td>46 28</td>
<td></td>
</tr>
<tr>
<td>4 (51–99%)</td>
<td>58 41</td>
<td>75 45</td>
<td></td>
</tr>
<tr>
<td>Poverty category</td>
<td></td>
<td></td>
<td>0.43</td>
</tr>
<tr>
<td>1</td>
<td>34 24</td>
<td>42 25</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>43 31</td>
<td>57 34</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>48 34</td>
<td>53 32</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>16 11</td>
<td>14 8</td>
<td></td>
</tr>
</tbody>
</table>

NOTE. Data are the percent of offices having each characteristic within the respondent group and the nonrespondent group.

*Specialty data were not available for one office.
†Provider counts were not available for 12 offices.
‡x² test.
§Fisher’s exact test.
||Two-sided exact Cochran-Armitage trend test.

### Table 3 • Computer and Internet Use in Physician Offices

<table>
<thead>
<tr>
<th>Office Location Category</th>
<th>Offices* N</th>
<th>Any Computer n % p</th>
<th>Web Access n % p</th>
<th>Broadband Web n % p</th>
<th>Practice Web Page n % p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hispanic</td>
<td>0.33</td>
<td>0.47</td>
<td>0.86</td>
<td>0.02</td>
<td></td>
</tr>
<tr>
<td>1 (0–19%)</td>
<td>35 32 91</td>
<td>26 74</td>
<td>8 23</td>
<td>10 29</td>
<td></td>
</tr>
<tr>
<td>2 (19–40%)</td>
<td>50 48 96</td>
<td>39 78</td>
<td>15 30</td>
<td>13 26</td>
<td></td>
</tr>
<tr>
<td>3 (40–65%)</td>
<td>22 19 83</td>
<td>15 68</td>
<td>8 35</td>
<td>5 23</td>
<td></td>
</tr>
<tr>
<td>4 (68–98%)</td>
<td>33 33 100</td>
<td>28 85</td>
<td>9 27</td>
<td>2 6</td>
<td></td>
</tr>
<tr>
<td>Nonwhite</td>
<td>0.84</td>
<td>0.91</td>
<td>0.52</td>
<td>0.31</td>
<td></td>
</tr>
<tr>
<td>1 (2–18%)</td>
<td>7 6 86</td>
<td>6 86</td>
<td>2 29</td>
<td>1 14</td>
<td></td>
</tr>
<tr>
<td>2 (18–32%)</td>
<td>31 31 100</td>
<td>23 74</td>
<td>6 19</td>
<td>10 32</td>
<td></td>
</tr>
<tr>
<td>3 (32–50%)</td>
<td>45 40 89</td>
<td>34 76</td>
<td>15 33</td>
<td>9 20</td>
<td></td>
</tr>
<tr>
<td>4 (51–99%)</td>
<td>57 55 97</td>
<td>45 78</td>
<td>17 29</td>
<td>10 18</td>
<td></td>
</tr>
<tr>
<td>Poverty</td>
<td>0.58</td>
<td>0.41</td>
<td>0.20</td>
<td>0.34</td>
<td></td>
</tr>
<tr>
<td>1 (0–6%)</td>
<td>34 33 97</td>
<td>27 79</td>
<td>7 21</td>
<td>7 21</td>
<td></td>
</tr>
<tr>
<td>2 (6–13%)</td>
<td>43 38 88</td>
<td>29 67</td>
<td>10 23</td>
<td>12 28</td>
<td></td>
</tr>
<tr>
<td>3 (13–23%)</td>
<td>48 45 94</td>
<td>38 79</td>
<td>18 38</td>
<td>10 21</td>
<td></td>
</tr>
<tr>
<td>4 (24–68%)</td>
<td>16 16 100</td>
<td>14 88</td>
<td>5 31</td>
<td>1 6</td>
<td></td>
</tr>
</tbody>
</table>

NOTE. Data are counts or percentages as noted in column headers. Tests of significance are two-sided exact Cochran-Armitage tests for trend across ordinal categories.

*Technology access data were missing for one office, resulting in a total n = 140.
concerns about the confidentiality and security of online health information systems, had a Cronbach’s alpha of 0.91.

Figure 2 shows the strongly non-normal distribution of each attitudinal scale score among the responding offices. On average, offices expressed moderate DIFFICULTY with current systems, high INTEREST in online systems, but also high levels of CONCERNS about online systems. The INTEREST and CONCERNS scales were positively correlated ($r = +0.23$, $p = 0.008$), but the difficulty scale was not correlated with either of the other scales. None of the scale scores were associated with the race/ethnic or income characteristics of the census tracts in which the offices were located. Table 4 shows that offices with Web access and those with practice management systems had significantly greater INTEREST in online patient information systems, yet they also had greater CONCERNS about the security and confidentiality of online patient information systems. These office features were not, however, associated with having more or less difficulty tracking patient information using current systems.

### Discussion

Web-based clinical applications hold the promise of systematically improving health care, but they could increase health disparities if physicians caring for disadvantaged segments of the population have less access. We hypothesized that physicians who practice in disadvantaged areas would have less access to the Internet and other technology resources than their peers located in wealthier, predominantly white communities. However, the study found that physician offices located in the poorest and highest-minority neighborhoods have Internet access that equals the access enjoyed by offices located elsewhere in the county. Among these offices in the county’s most disadvantaged areas, about 80% had some form of Web access, a proportion that is consistent with the 2001 national survey finding that 78% of physicians were current users of the Internet. In addition, we found that nearly a third of offices with Internet access had broadband rather than modem access, even in the most disadvantaged communities.

Although access to information technology was high, our data indicate that computers and the Internet were being used less for clinical purposes, such as immunization tracking, than they were for administrative purposes, such as practice management and insurance eligibility checking. Nonetheless, most offices expressed a high level of interest in new online clinical systems, despite also expressing high levels of concern about these systems. The finding that offices with Web access or a practice management system had greater interest in online clinical systems could have two opposite explanations. Preexisting interests might have led to

![Figure 2](image-url)

**Figure 2.** Distribution of attitude scale scores among offices. (a) DIFFICULTY tracking patient information; (b) INTEREST in online patient information; (c) CONCERNS about online patient information.

Concerns about the confidentiality and security of online health information systems, had a Cronbach’s alpha of 0.91.

Table 4 - Attitudes toward Online Systems among Physician Offices

<table>
<thead>
<tr>
<th>Office Category</th>
<th>Current DIFFICULTY ($n = 138$)</th>
<th>INTEREST ($n = 136$)</th>
<th>CONCERNS ($n = 134$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
<td>4.4 (3.1–6.1)</td>
<td>8.6 (7.0–9.7)</td>
<td>7.8 (7.0–9.3)</td>
</tr>
<tr>
<td>Web access in office</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>4.4 (3.1–6.6)</td>
<td>8.9 (7.7–9.9)</td>
<td>8.1 (7–9.2)</td>
</tr>
<tr>
<td>No</td>
<td>4.0 (2.2–5.7)</td>
<td>7.2 (6.3–8.9)</td>
<td>7 (4.2–8.5)</td>
</tr>
<tr>
<td>p-value for yes versus no*</td>
<td>0.32</td>
<td>0.001</td>
<td>0.01</td>
</tr>
<tr>
<td>Practice management system</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>4.4 (3.1–6.6)</td>
<td>9.0 (8.2–9.9)</td>
<td>8.5 (7–9.3)</td>
</tr>
<tr>
<td>No</td>
<td>4.0 (2.7–5.7)</td>
<td>7.9 (6.3–9.0)</td>
<td>7 (5.5–8.5)</td>
</tr>
<tr>
<td>p-value for yes versus no*</td>
<td>0.43</td>
<td>0.0006</td>
<td>0.002</td>
</tr>
</tbody>
</table>

*Two-sided Wilcoxon rank sum test.

NOTE. Data are median scores with interquartile ranges (25th percentile to 75th percentile) for each attitudinal scale. Each scale had a total range from 1 to 10, with 1 representing the lowest level of difficulty, interest, or concerns.
the adoption of these systems or the experience of having these systems might have led to a greater awareness of the possible benefits from clinical applications. However, pre-existing attitudes would not be a likely explanation of the finding that offices with Web access or a practice management system had greater concerns about online clinical systems. Instead, the finding of greater concerns would more likely be due to a greater awareness of risks among those having more experience.

The patterns of information technology use were consistent across geographic locales for all uses except the maintenance of a practice Web page. The lower frequency of Web pages for offices in more heavily Hispanic neighborhoods may be due to offices in these areas understanding the low likelihood of their patients’ having Web access. Interests in and concerns about online systems also did not differ for physicians in more disadvantaged areas.

If offices in more disadvantaged neighborhoods have a less-favorable payer mix, including more uninsured patients, and they therefore have fewer financial resources, our findings would suggest that nonfinancial barriers may be more important obstacles to technology adoption in physician offices. These nonfinancial barriers might include inadequate skills with basic computing tasks such as Web browsing and file management. Programs that simply provide financial support for purchasing commonly available technologies such as Internet access and practice management systems might fail to foster adoption among the remaining offices.

A few limitations should be recognized in interpreting this study’s results. The survey’s response rate of 46% could have biased our estimates of Internet access or attitudes. For example, if offices with Web access were more likely to respond to the survey, then our finding of 78% access would be an overestimate. Conversely, if offices without Web access were more likely to respond, perhaps to emphasize their inability to participate in proposed online programs, then our finding would be an underestimate. The availability of Web-based survey submission could have exacerbated a bias toward more responses from offices already having Web access, but because only 38 offices of 108 reporting Web access chose Web-based submission, any such effect was probably small. More importantly, because the response rate did not differ by the race/ethnicity and income of the offices’ locations, it is likely that the finding of no “digital divide” among offices would remain, even if the overall Internet access rate were overestimated.

Because our survey did not assess the characteristics of patients within the offices, we were limited to classifying offices based on their neighborhood demographic characteristics. The finding of lower office densities in the wealthiest and lowest-minority neighborhoods suggests that zoning restrictions likely force many individuals who live in these areas to obtain care outside of their own neighborhoods. It seems unlikely, however, that the wealthiest patients would seek care at the 30 offices located in Orange County’s poorest neighborhoods, where the poverty rates ranged from 24% to 68%. The finding that 53% of these 30 offices responded to the survey, and that 88% of these had Web access in the office, strongly suggests that physicians serving the poor in Orange County can access Web-based services to the same extent as their peers. Future surveys might further characterize offices by asking about their patients’ insurance base and race/ethnicity. The latter measure may be imprecise, however, because offices have little incentive to assess patients’ race/ethnicity accurately. Offices would have even less ability to accurately estimate their patients’ wealth or incomes.

Caution also should be exercised when generalizing the study’s results beyond Orange County in the year 2001. Internet access had grown dramatically from 1999 to 2001, and access patterns may have continued to change since then. In addition, Orange County is wealthier than the typical large, urban county, and African Americans are severely underrepresented. Nonetheless, the county has areas with high poverty rates and large disadvantaged minority populations. Orange County also differs from many other counties in that a county-organized managed care plan (CalOptima) administers its Medicaid program. If this arrangement has offset the disadvantages of practicing in the poorest neighborhoods, then findings from Orange County might not be reproduced elsewhere. However, all CalOptima providers accept a mix of payer types, so those in wealthier neighborhoods probably retain a more favorable payer mix. Furthermore, CalOptima had not offered any specific incentives for Web use, so physicians in the county’s most disadvantaged areas had adopted Internet access for their own reasons, which would likely be similar to the motivations for any physician.

Overall, our findings of high Internet access and high interest in online systems among offices located even in the poorest and highest-minority neighborhoods suggests that physicians’ offices can provide a bridge across the digital divide, enabling Web-based health services that directly address health disparities. Additional studies are needed to determine whether these findings are true for other areas of the nation, including rural areas and more traditional urban areas. Further studies also are needed to determine why a minority of physicians’ offices have lagged in adopting Web technologies.

References


Appendix

Pediatric Services & Technology Readiness Survey

You can respond online at HLN’s website, http://www.hln.com/evalsamples/survey.html

PEDIATRIC SERVICE QUESTIONS

Please involve physicians/clinical staff in answering questions 1 to 9.

1. Do you have a way to track preventive services without the patient chart? □ Yes □ No

Circle the response that is most accurate for your practice.

2. How difficult is it for you to track your patients for:
   Number of well child visits ......................................................... 1 2 3 4
   Immunization status .............................................................. 1 2 3 4
   TB screening results ............................................................. 1 2 3 4
   Lead screening results ........................................................... 1 2 3 4
   Hearing/vision screening results ............................................. 1 2 3 4
   Developmental assessment concerns ..................................... 1 2 3 4
   Referral tracking and clarification ........................................ 1 2 3 4
   Services above that your patients receive from other providers ...... 1 2 3 4

3. Would you like to have an electronic copy of your patients’ well child visits? □ Yes □ No

   □ INTERESTED □ VERY INTERESTED
   1 2 3 4
4. If there were a way to track your patients electronically, which of the following would you want to track?  

<table>
<thead>
<tr>
<th>NOT USEFUL</th>
<th>VERY USEFUL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of well child visits</td>
<td>1 2 3 4</td>
</tr>
<tr>
<td>Immunization status</td>
<td>1 2 3 4</td>
</tr>
<tr>
<td>TB screenings results</td>
<td>1 2 3 4</td>
</tr>
<tr>
<td>Lead screening results</td>
<td>1 2 3 4</td>
</tr>
<tr>
<td>Hearing/vision screening results</td>
<td>1 2 3 4</td>
</tr>
<tr>
<td>Developmental assessment concerns</td>
<td>1 2 3 4</td>
</tr>
<tr>
<td>Referral tracking and confirmation</td>
<td>1 2 3 4</td>
</tr>
<tr>
<td>Services above that your patients receive from other providers</td>
<td>1 2 3 4</td>
</tr>
</tbody>
</table>

5. Rate your interest in being able to make computer-generated patient-based hard copies of the following for your charts/patients:  

<table>
<thead>
<tr>
<th>NOT INTERESTED</th>
<th>VERY INTERESTED</th>
</tr>
</thead>
<tbody>
<tr>
<td>CA Immunization Record (yellow card)</td>
<td>1 2 3 4</td>
</tr>
<tr>
<td>Immunization record meeting medical chart requirements</td>
<td>1 2 3 4</td>
</tr>
<tr>
<td>Patient immunizations given by other providers</td>
<td>1 2 3 4</td>
</tr>
<tr>
<td>Information on previous adverse reactions</td>
<td>1 2 3 4</td>
</tr>
<tr>
<td>Vaccines recommended for today's visit</td>
<td>1 2 3 4</td>
</tr>
<tr>
<td>PM 160* from previous visit to your office</td>
<td>1 2 3 4</td>
</tr>
<tr>
<td>PM 160* from previous visit to another provider</td>
<td>1 2 3 4</td>
</tr>
<tr>
<td>Health Exam Form for School Entry</td>
<td>1 2 3 4</td>
</tr>
<tr>
<td>Patient notice/postcard for immunizations due/past due</td>
<td>1 2 3 4</td>
</tr>
<tr>
<td>Other (specify: )</td>
<td>1 2 3 4</td>
</tr>
</tbody>
</table>

* Well Child Visit Encounter Form

6. Rate your interest in being able to make the following hard copy practice-based computer-generated reports:  

<table>
<thead>
<tr>
<th>NOT INTERESTED</th>
<th>VERY INTERESTED</th>
</tr>
</thead>
<tbody>
<tr>
<td>List of patients with well child visits due/past due</td>
<td>1 2 3 4</td>
</tr>
<tr>
<td>List of patients with immunizations due/past due</td>
<td>1 2 3 4</td>
</tr>
<tr>
<td>Practice immunization rate assessment</td>
<td>1 2 3 4</td>
</tr>
<tr>
<td>Practice immunization rate report based on HEDIS criteria</td>
<td>1 2 3 4</td>
</tr>
<tr>
<td>Weekly/monthly practice shot count reports (Vaccine usage)</td>
<td>1 2 3 4</td>
</tr>
<tr>
<td>Other (specify: )</td>
<td>1 2 3 4</td>
</tr>
</tbody>
</table>

7. Given what you know about immunization registries currently, would your practice be interested in participating in a countywide immunization registry?  

<table>
<thead>
<tr>
<th>NOT INTERESTED</th>
<th>VERY INTERESTED</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 2 3 4</td>
</tr>
</tbody>
</table>

8. How would you rate your practice’s concerns about a Web-based patient electronic information system?  

<table>
<thead>
<tr>
<th>NOT CONCERNED</th>
<th>VERY CONCERNED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accuracy and reliability of the data</td>
<td>1 2 3 4</td>
</tr>
<tr>
<td>Timely access to the central database</td>
<td>1 2 3 4</td>
</tr>
<tr>
<td>Security of the central database</td>
<td>1 2 3 4</td>
</tr>
<tr>
<td>Confidentiality and privacy of patient data</td>
<td>1 2 3 4</td>
</tr>
<tr>
<td>Cost to my practice to participate</td>
<td>1 2 3 4</td>
</tr>
<tr>
<td>Need for computer equipment</td>
<td>1 2 3 4</td>
</tr>
<tr>
<td>Additional work for my staff to learn to use the system</td>
<td>1 2 3 4</td>
</tr>
<tr>
<td>Additional work for my staff to use the system</td>
<td>1 2 3 4</td>
</tr>
<tr>
<td>Other (identify: )</td>
<td>1 2 3 4</td>
</tr>
</tbody>
</table>

9. How would you rate the concerns of your patients and their families about their health information being in a Web-based patient electronic information system?  

<table>
<thead>
<tr>
<th>NOT CONCERNED</th>
<th>VERY CONCERNED</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 2 3 4</td>
<td></td>
</tr>
</tbody>
</table>

TECHNOLOGY QUESTIONS

Please involve information systems staff/office managers in answering questions 10 through 19.

10. Current automation environment:  

| |  
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ☐ Yes | ☐ No | ☐ If yes, who uses them? | ☐ Check all that apply | ☐ Doctors | ☐ Clinical Staff | ☐ Admin/Clerical |

☐ No: If no, do you have plans to use them in the future?  

| ☐ Yes | ☐ No | ☐ If so, when? | ☐ 2001 | ☐ 2002 | ☐ in 5 years |

☐ No: If no, please skip to question #15.

11. Characteristics of computers:  

| How many of the following are currently operational in your practice? |  
|---|---|---|---|---|---|
| ☐ PCs | ☐ Macs | ☐ Other Desktops | ☐ Terminals Linked to a Mainframe |

12. Existing Practice Management System and Vendors  

| Do you use a Practice Management System? | ☐ Yes | ☐ No |
| Do you have plans to install a new system within the next six months? | ☐ Yes | ☐ No |
| If so, when? |  
| ☐ In house staff | ☐ A Vendor | ☐ Third party |

What is the name of your existing or proposed system (if a product)?  

The current system is operated by:  

| ☐ In house staff | ☐ A Vendor | ☐ Third party |

Can desktop computers be used for other applications as well?  

| ☐ Yes | ☐ No |


13. Use of the Internet:
Do you have computers capable of accessing the World Wide Web? □ Yes □ No
If no, skip to question #14.

If yes, these computers are located in the: (Check all that apply.)
□ Front office □ Examining rooms □ Physicians offices □ Other
(please specify: ______________________)

Which Internet browser are you using?
□ Explorer □ Netscape □ Don’t Know □ Other
(please specify: ______________________)

Version Number ______________________

Who uses the Internet in your practice? □ Doctors □ Clinical Staff □ Admin/Clerical
How often does your staff use the Internet to retrieve information?
□ Daily □ Weekly □ Monthly □ Occasionally □ Never
How often does your staff use the Internet to retrieve/store patient information?
□ Daily □ Weekly □ Monthly □ Occasionally □ Never

Check the boxes for all of the ways your practice uses the Internet:
□ Shopping/e-commerce □ Patient management/contact
□ Insurance eligibility verification □ Research
□ Insurance authorization request □ Practice Web page
□ Insurance claims submittal/payment □ Other (specify ______________________)

What kind of connection do you have?
□ Modem □ Shared connection via leased line (<1.5Mb/sec)
□ Shared connection via DSL/Cable □ Shared connection via T-1 (1.5Mb/sec) or higher

14. How do you submit Well Child Visit Encounter Form (PM160) low-income/non-Medi-Cal claims to the state (EDS)? □ Electronic now □ Electronic previously, but not now □ Paper
→ Why did you stop?

15. Use of 3rd Party Payers
Do you submit claims to other 3rd party payers (HCFA 1500)? □ Yes □ No
If yes, how?
□ Electronically □ Paper □ Both
If yes, through what intermediary? (Check all that apply)
□ Clearinghouse □ Billing service □ Submit directly to intermediary

16. In order to participate in an electronic information system, what additional resources will you need?
(You do not need to check all that apply)
□ Computers (desktop) □ Internet Connection □ Additional staff □ Other
(specify ______________________)

17. Would you be interested in assessment or training to assist you in participating in the pediatric tracking system or immunization registry? □ Yes □ No
If yes, please check all that apply:
□ Assessment of your practice needs □ Basic Computer Skills Training
□ Basic Internet Use Training □ Training in the new information system
□ Ongoing technical support for the new system □ Refresher training to ensure full utilization and benefit from the new system
□ Other (Please describe: ______________________)

18. If your practice’s staff would like to participate in training on how to use the electronic information system, which languages are preferred for training and materials? (Check all that apply)
□ English □ Spanish □ Vietnamese □ Other (specify: ______________________)

19. As these new electronic information systems are being developed, would you be interested in participating initially in a system that only provides well child visit/immunization information for your CalOptima patients? □ Yes □ No

Physician/Facility Information
Name of practice/facility: ________________________ Medi-Cal ID # ________________________
Address: ____________________________ Street ____________________________ City ____________________________ Zip Code ____________________________
Name of contact person for survey: ____________________________ Date completed: ____________________________
Position: □ Physician □ Nurse □ Other clinician □ Administrator/office manager □ Other
Phone #: ____________________________ Fax #: ____________________________ Email: ____________________________
Number of physicians at this office: _____ Number administrative/clerical staff at this office: _____
Name of person who makes/coordinates practice decisions regarding technology: ____________________________
Phone #: ____________________________ Fax #: ____________________________ Email: ____________________________

Please check the gift you’d like for completing this survey:
□ $25 Gift Certificate to Office Supply Store □ Dessert Gift Basket
If you complete the survey on the Web, there will be a special "bonus" drawing of a $1,000 gift certificate to an Office Supply Store!