# Use of an Electronic Patient Portal Among Disadvantaged Populations

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**BACKGROUND:** Electronic patient portals give patients access to information from their electronic health record and the ability to message their providers. These tools are becoming more widely used and are expected to promote patient engagement with health care.

**OBJECTIVE:** To quantify portal usage and explore potential differences in adoption and use according to patients' socioeconomic and clinical characteristics in a network of federally qualified health centers serving New York City and neighboring counties.

**DESIGN:** Retrospective analysis of data from portal and electronic health records.

**PARTICIPANTS:** 74,368 adult patients seen between April 2008 and April 2010.

**MAIN MEASURES:** Odds of receiving an access code to the portal, activating the account, and using the portal more than once

**KEY RESULTS:** Over the 2 years of the study, 16% of patients (n=11,903) received an access code. Of these, 60% (n=7138) activated the account, and 49% (n=5791) used the account two or more times. Patients with chronic conditions were more likely to receive an access code and to become repeat users. In addition, the odds of receiving an access code were significantly higher for whites, women, younger patients, English speakers, and the insured. The odds of repeat portal use, among those with activated accounts, increased with white race, English language, and private insurance or Medicaid compared to no insurance. Racial disparities were small but persisted in models that controlled for language, insurance, and health status.

**CONCLUSIONS:** We found good early rates of adoption and use of an electronic patient portal during the first 2 years of its deployment among a predominantly low-income population, especially among patients with chronic diseases. Disparities in access to and usage of the portal were evident but were smaller than those reported recently in other populations. Continued efforts will be needed to ensure that portals are usable for and used by disadvantaged groups so that all patients benefit equally from these technologies.

## INTRODUCTION

Improving patients' access to health information and their communication with providers are important steps toward health promotion, self-management of disease, and shared medical decision-making. One technology that has the potential to support these goals is the electronic patient portal, which gives patients a view of selected data from a provider's electronic health record (EHR) and may allow patients to perform tasks such as exchanging secure messages with physicians, requesting appointments, and ordering medication refills. Because the portal is dependent on a single EHR, some[1,2] have called it a "tethered" personal health record (PHR).

Portals and PHRs are widely expected to help promote health at both the individual and the population level by facilitating patient–provider communication, helping people access and manage personal health data, assisting in self-monitoring and self-care, and engaging individuals more fully in their own health care and wellness.[1–4] Portals and PHRs are currently used by only about 7% of Americans[5], but they are growing in popularity[5,6] and are likely to become more common in light of the Department of Health and Human Services' 2010 rule to encourage "meaningful use" of health information technology, under which providers and hospitals can receive incentives for measures such as providing patients with electronic copies of their health information upon request.[7]

To benefit from such electronic communication, however, consumers and patients will require computer and Internet access[8], computer literacy[9], health literacy[10,11], and numeracy.[12] It is also possible that they will need particular attitudes, such as confidence in their written communication skills or trust in doctors or the health-care system.[13,14] Thus, it seems probable that educationally, economically, or socially disadvantaged individuals will be less likely to use these electronic tools than those who are better off, and that any benefits from portal use will be unequally distributed.

In fact, racial and educational disparities have been found in use of portals.[15–17] Among portal registrants at the Cleveland Clinic, whites were more likely than blacks to use the account after registering for it.[15] A cohort study at Kaiser Permanente Georgia found that portal registration was more likely among whites, those with Internet access at baseline, and those with more education.[16] At a public HIV/AIDS clinic, early adopters of a customized patient portal were more likely to be white and non-Hispanic than the overall clinic population.[17]

Each of these studies, however, focused primarily on one part of the process of engaging patients: either portal registration, or portal usage among those already registered. If electronic portals are to become useful across the entire population, disparities should be minimized throughout the process of patient engagement. Do disparities in usage arise because of unequal access to portal accounts? If so, an appropriate response might be policies to reduce disparities in portal access, such as automatically providing access codes for all patients rather than assigning them upon request of either the provider or the patient. Alternately, do disparities arise when patients are given portal access but do not become regular users? If this is the case, it would suggest the need for measures to help patients to activate these accounts and become regular users.

In this retrospective analysis, we examined demographic and clinical factors associated with (a) receipt of a portal access code, (b) activation of the portal account, and (c) use of the portal more than once among patients in a safety-net clinic over 2 full years of data.

## METHODS

### Setting & Participants

We conducted our study using data from the Institute for Family Health (IFH), a network of federally qualified health centers that provides primary care to a predominantly low-income population in New York City and the Hudson Valley north of the city, serving a highly racially, ethnically, and socio-economically diverse population. IFH uses the EpicCare EHR and in 2008 deployed Epic's English-language MyChart patient portal. The portal went live in April 2008; New York City patients began to be enrolled immediately, and Hudson Valley patients 6 months later. In February 2009, IFH launched voluntary provider training and a poster campaign within all its health centers, but there was no policy requiring systematic enrollment for all patients. An access code for the portal could be generated by the provider upon request of either the provider or the patient; after receiving an access code, the patient had to visit the portal website to activate the account, and then could use the portal freely.

To be included in the analysis, an individual had to be an active patient of the Institute, defined as having had at least one encounter at an IFH health center between when the patient portal went live in April 2008 and April 2010. Patients under 18 were excluded.

Data were obtained from the Institute's EHR system and its patient portal (EpicCare and MyChart, Epic Systems, Verona, Wisconsin). The portal database was queried for patient-level data about access codes, activation of portal accounts, and usage. The patient's primary care provider, demographic characteristics (sex, age, race, preferred language), and insurance status were obtained from the EHR data. In addition, we identified presence of nine chronic conditions by applying

algorithms developed by IFH for quality improvement purposes to the ICD-9 codes in the patient's current problem list. These algorithms scan the patient record for ICD-9 codes, and then use the hierarchical structure of ICD-9 to group together all codes pertaining to a specific chronic condition.

### Statistical Analysis

Multivariate logistic regressions were used to determine characteristics associated with receiving an access code, activating an account, and using the account more than once. We controlled for duration of portal access with two variables: number of months since the access code was received, and the number of months since the account was activated. Predictor variables significant at the 0.05 level in bivariate analyses were included in multivariate models; in all multivariate models, we also controlled for demographic characteristics and duration of portal access to address potential confounders. Because the individual chronic disease diagnoses were components of the total number of diagnoses, they could not be added to the same multivariate models. Separate models were constructed for these, using diagnoses significant on bivariate analysis, while also adjusting for sex, age, race, language, insurance type, number of clinical visits, health center location, number of months since access code was issued, and the number of months since the account was activated. Analyses were performed in SAS version 9.2 (SAS Institute, Cary, NC).The study was approved by the IRBs of Columbia University, Weill Cornell Medical College, and the Institute for Family Health.

## RESULTS

A total of 74,368 adults met the definition of active patients. They were racially and ethnically heterogeneous, and only 39% carried commercial insurance (Table 1). Hypertension and hyperlipidemia were the most prevalent chronic conditions. Patients of the Hudson Valley practices were older, more likely to have private insurance or Medicare, and more likely to be white than patients in the two urban boroughs. In the Bronx, nearly half of patients were Hispanic, and 41% were covered by Medicaid.

Of the active patients, 11,903 (16%) received an access code to the portal, 7138 (60%) of whom activated their accounts ("users") (Table 2). The account was used twice or more by 5791 "repeat users," representing 81% of those who activated their account and 49% of the total codes issued. Median frequency of use was 0.8 times per month since account was activated. A small number of patients logged in several times a day almost every day, with the most frequent user accumulating 1532 logins over the two-year period. Of the 439 providers identified as caring for eligible study patients, 289 (65.8%) had patients who received a portal access code. These providers had a median of eight patients receiving access codes (interquartile range: 1—38).

### Issuing of Access Codes

In bivariate analyses, the following variables were statistically significantly associated with likelihood of getting an access code: sex, age, race, language, insurance type, clinic location, number of encounters, number of diagnoses, and the following individual diagnoses: alcoholism, hepatitis, HIV/AIDS, asthma, depression,

**Table 1. Characteristics of Institute for Family Health Patients by Health Center Location**

| Patient Characteristic | Location of health center | | | |
| --- | --- | --- | --- | --- |
| | Manhattan | Bronx | Hudson Valley | All sites |
| | N=31,414 | N=15,667 | N=27,287 | N=74,368 |
| Female Sex, n (%) | 19,983 (64) | 10,384 (66) | 16,035 (59) | 46,402 (62) |
| Mean age (SD) | 37 (14) | 39 (15) | 45 (18) | 40 (16) |
| Race/ethnicity, n (%) | | | | |
|   Black/African American | 4881 (16) | 5103 (33) | 1925 (7) | 11,909 (16) |
|   Hispanic | 4857 (15) | 7636 (49) | 1640 (6) | 14,133 (19) |
|   White | 14,358 (46) | 399 (3) | 17,881 (66) | 32,638 (44) |
|   Other | 2868 (9) | 606 (4) | 631 (2) | 4105 (6) |
|   Missing/Unknown | 4450 (14) | 1923 (12) | 5210 (19) | 11,583 (15) |
| Preferred language, n (%) | | | | |
|   English | 28,619 (91) | 10,789 (69) | 23,584 (86) | 62,992 (85) |
|   Spanish | 662 (2) | 3499 (22) | 678 (3) | 4839 (6) |
|   Other | 2133 (7) | 1379 (9) | 3025 (11) | 6537 (9) |
| Insurance type, n (%) | | | | |
|   Private | 15,091 (48) | 3649 (23) | 10,437 (38) | 29,177 (39) |
|   Medicaid | 4321 (14) | 6360 (41) | 5993 (22) | 16,674 (22) |
|   Medicare | 1556 (5) | 1027 (6) | 5948 (22) | 8531 (12) |
|   Other public* | 820 (3) | 1030 (7) | 1150 (4) | 3000 (4) |
|   Uninsured | 9626 (31) | 3601 (23) | 3759 (14) | 16,986 (23) |
| Mean number of clinical visits over 2 years (SD) | 5 (8) | 7 (12) | 7 (9) | 6 (9) |
| Chronic conditions, n (%):† | | | | |
|   Hypertension | 2796 (9) | 2628 (17) | 6275 (23) | 11,699 (16) |
|   Hyperlipidemia | 2510 (8) | 2464 (16) | 4790 (18) | 9764 (13) |
|   Asthma | 2146 (7) | 1851 (12) | 2420 (9) | 6417 (9) |
|   Diabetes | 1223 (4) | 1385 (9) | 2688 (10) | 5296 (7) |
|   Depression | 1906 (6) | 1646 (11) | 1050 (4) | 4602 (6) |
|   Drug abuse or dependency | 588 (1.9) | 493 (3.1) | 662 (2.4) | 1743 (2.3) |
|   Chronic hepatitis (B, C, or other) | 411 (1.3) | 393 (2.5) | 499 (1.8) | 1303 (1.8) |
|   Alcoholism | 388 (1.2) | 244 (1.6) | 456 (1.7) | 1088 (1.5) |
|   HIV/AIDS | 407 (1.3) | 365 (2.3) | 154 (0.6) | 926 (1.3) |
| Mean number of chronic conditions (SD) | 0.39 (0.82) | 0.73 (1.09) | 0.70 (0.99) | 0.58 (0.96) |
| One or more chronic conditions, n (%) | 7825 (25) | 6584 (42) | 11332 (42) | 25741 (35) |
| Among those with one or more chronic conditions, mean number of conditions (SD) | 1.59 (0.89) | 1.75 (1.03) | 1.68 (0.86) | 1.67 (0.92) |

*Includes New York State programs Family Health Plus and Child Health Plus*

*† Conditions were not mutually exclusive, so percentages in this section do not sum to 100%*

and hyperlipidemia. Multivariate models (Table 3, column 1) showed that access codes were significantly more likely to be issued to women, younger patients, whites, speakers of English and languages other than English or Spanish, and those with insurance, more clinical visits, and more chronic illnesses. Patients in the urban sites were more likely to receive access codes than patients in the Hudson Valley; however, Hudson Valley sites implemented the portal 6 months after New York City sites. Stratified analyses (not shown) demonstrated that all site-specific trends were similar to the overall trends except with respect to age. In Manhattan,

odds of receiving a code was not associated with age, whereas in the Bronx, older patients were less likely to receive a code and in the Hudson Valley, older patients were more likely to receive a code.

The racial disparities reflected by the odds ratios in Table 3, although statistically significant, were relatively small in absolute size. That is, in the complete data set, 16% (11,903/74,368) of all patients received access codes; among black patients, the proportion was 16% (1937/11,909); among white patients, it was 18% (5887/32,638); and among Hispanic patients, it was 15% (2167/14,133).

**Table 2. Portal Access Among Institute for Family Health Patients by Health Center Location**

| | Manhattan | Bronx | Hudson Valley | Total |
| --- | --- | --- | --- | --- |
| Number of access codes issued | 7,856 | 1,907 | 2,140 | 11,903 |
| Number of patients who activated account (% of all patients) | 4,340 (55%) | 1,377 (72%) | 1,421 (66%) | 7,138 (60%) |
| Number of patients who activated account the same day code was issued (% of those who activated) | 1,123 (26%) | 929 (67%) | 895 (63%) | 2,947 (41%) |
| Number of patients who used portal more than once (% of those who activated) | 3,660 (84%) | 1,040 (76%) | 1,091 (77%) | 5,791 (81%) |
| Median number of logins per month (interquartile range) | 0.9 (0.3, 2.1) | 0.7 (0.2, 2.0) | 0.8 (0.2, 2.0) | 0.8 (0.3, 2.1) |

**Table 3. Characteristics Associated with Odds of Receiving a Portal Access Code, Activating the Portal, and Using It More Than Once**

| Patient Characteristic | Adjusted Multivariate OR (95% CI) | | |
|---|---|---|---|
| | Odds of receiving a portal access code | Odds of activating portal account | Odds of using portal more than once |
| Female Sex | 1.06 (1.01, 1.11) | 1.07 (0.98, 1.15) | 1.15 (1.01, 1.32) |
| Age (10-year increment) | 0.97 (0.96, 0.99) | 1.05 (1.01, 1.08) | 0.99 (0.93, 1.04) |
| Race/ethnicity | | | |
| Black/African American | Reference | Reference | Reference |
| Hispanic | 1.20 (1.12, 1.30) | 1.35 (1.18, 1.55) | 1.13 (0.92, 1.40) |
| White | 1.60 (1.50, 1.71) | 1.69 (1.50, 1.90) | 1.54 (1.26, 1.87) |
| Other | 1.21 (1.10, 1.34) | 1.49 (1.25, 1.78) | 1.27 (0.95, 1.71) |
| Missing/Unknown | 1.06 (0.97, 1.17) | 1.46 (1.23, 1.74) | 1.85 (1.37, 2.49) |
| Language | | | |
| Spanish | Reference | Reference | Reference |
| English | 2.80 (2.45, 3.20) | 1.60 (1.24, 2.07) | 1.72 (1.20, 2.46) |
| Other | 2.18 (1.84, 2.59) | 1.71 (1.23, 2.40) | 1.39 (0.86, 2.27) |
| Insurance Type | | | |
| Private | 4.10 (3.84, 4.37) | 1.71 (1.51, 1.94) | 1.67 (1.36, 2.01) |
| Medicaid | 2.19 (2.02, 2.37) | 1.23 (1.08, 1.45) | 1.47 (1.16, 1.87) |
| Medicare | 1.88 (1.69, 2.09) | 1.29 (1.06, 1.58) | 1.32 (0.97, 1.81) |
| Other public* | 3.16 (2.81, 3.56) | 1.70 (1.37, 2.13) | 1.12 (0.81, 1.55) |
| Uninsured | Reference | Reference | Reference |
| Number of clinical visits | 1.042 (1.039, 1.044) | 1.012 (1.007, 1.018) | 1.005 (0.99, 1.01) |
| Number of chronic conditions | 1.15 (1.13, 1.18) | 1.01 (0.96, 1.05) | 1.15 (1.06, 1.24) |
| Health center location | | | |
| Manhattan | 5.23 (4.94, 5.54) | 0.72 (0.64, 0.80) | 1.69 (1.41, 2.02) |
| Bronx | 2.63 (2.42, 2.85) | 2.09 (1.77, 2.46) | 1.41 (1.11, 1.79) |
| Hudson Valley | Reference | Reference | Reference |
| Number of months since code issued | (Not applicable) | 1.04 (1.03, 1.05) | (Not applicable) |
| Number of months since activation | (Not applicable) | (Not applicable) | 1.06 (1.05, 1.07) |
| Account activated on the same day access code was generated | (Not applicable) | (Not applicable) | 0.82 (0.72, 0.94) |

*Includes New York State programs Family Health Plus and Child Health Plus*

## Activation of Account

In bivariate analyses, the following variables were significantly associated with likelihood of activating the account: age, race, insurance type, clinic location, number of encounters, number of diagnoses, number of months since the access code was issued, and the following three individual diagnoses: HIV, depression, and hyperlipidemia. Multivariate models (Table 3, column 2) showed that activation was significantly more likely among older patients, non-blacks, speakers of English or other languages compared to Spanish speakers, the privately insured, patients in the Bronx, and those with more clinical visits. Odds of activation increased over time after the access code was issued, with 85% of patients activating their code within 30 days. In the Bronx, odds of activation were much higher than in the other regions. This may have been at least in part because several Bronx clinicians helped patients activate their account in the office on the same day the access code was issued.

## Repeat Portal Use

In analyzing likelihood of repeat use, we added "same-day activation" as well as months since activating the account as potential predictors (Table 3, column 3). In bivariate analyses, the following variables were significantly associated with repeat use: race, language, insurance type, clinic location, number of encounters, number of diagnoses, number of months since access code was issued, number of months since account was activated, and 2 diagnoses: HIV and hyperlipidemia. In the multivariate models (Table 3), we found that repeat use was significantly more likely among whites, English speakers, those with commercial insurance or Medicaid, those in either Manhattan or the Bronx, and those with more chronic illnesses. Also, odds of repeat use rose over time after the date of activation. In contrast, those who activated their account the same day they received an access code were less likely to become repeat users.

Among portal users, frequency of portal use was correlated with number of clinical visits (r=0.31, p < 0.001), number of diagnoses (r=0.18, p < 0.001), and age (r=0.08, p < 0.001). In addition, age was associated with number of clinical visits (r= 0.13, p < 0.001) and number of diagnoses (r=0.41, p < 0.001).

## Clinical Diagnoses

Table 4 shows the results for each diagnosis in multivariate models in which individual diagnoses were substituted for diagnosis count. In bivariate analyses, the following diagnoses were associated with at least one of the outcomes of interest: hyperlipidemia, asthma, depression, chronic hepatitis, alcoholism, and HIV /AIDS (individual lists of significant predictors appear in footnotes to Table 4). The multivariate model results show that hyperlipidemia, asthma, and depression were associated with higher odds of having a portal access code generated; HIV/ AIDS was associated with higher odds but the association was not

**Table 4.**  **Clinical Diagnosis Groups Associated with Odds of Receiving a Portal Access Code, Activating the Portal, and Using It More than Once**

| Patient Characteristic | Multivariate OR (95% CI) | | |
|---|---|---|---|
| | Odds of receiving a portal access code[1] | Odds of activating portal account[2] | Odds of using portal more than once[3] |
| Presence of: | | | |
| Hyperlipidemia | 1.65 (1.54, 1.76) | 1.11 (0.99, 1.25) | 1.27 (1.06, 1.53) |
| Asthma | 1.27 (1.18, 1.36) | – | – |
| Depression | 1.13 (1.04, 1.23) | 1.10 (0.96, 1.26) | – |
| Chronic hepatitis (B, C, other) | 0.96 (0.82, 1.14) | – | – |
| Alcoholism | 0.92 (0.77, 1.10) | – | – |
| HIV/AIDS | 1.17 (0.98, 1.39) | 1.56 (1.19, 2.07) | 1.15 (0.74, 1.78) |

1. *This model included only diagnoses statistically significant on bivariate analysis, which were: hyperlipidemia, asthma, depression, chronic hepatitis, alcoholism, HIV/AIDS*
2. *This model included only diagnoses statistically significant on bivariate analysis, which were: hyperlipidemia, depression, HIV/AIDS*
3. *This model included only diagnoses statistically significant on bivariate analysis, which were: hyperlipidemia, HIV/AIDS*

statistically significant. Only HIV/AIDS was associated with increased likelihood of activating the account once the access code was generated. Only hyperlipidemia was statistically significantly associated with increased odds of using the portal repeatedly.

## DISCUSSION

In this large retrospective study of portal use at a network of federally qualified health centers, we found differences in electronic portal access and use on the basis of race, ethnicity, sex, language, insurance type, age, and health status. These disparities were evident first in differences in the likelihood of receiving an access code. Some of the disparities persisted across the likelihood of activating the portal account and likelihood of using it more than once. For example, racial and ethnic minorities, non-English speakers, and people without commercial insurance were less likely to receive access to the portal, and then there were additional decreases in their likelihood of activating the portal account and of using it. By contrast, men were less likely than women to receive portal access codes, but there were no significant gender-based disparities in activation or usage. Also, older patients were less likely to receive portal access, but older patients who did receive portal access were actually more likely to activate the account.

The disparities could be caused by patient self-selection, selection by clinicians, or some combination of these factors. However, even among patients who did receive access codes, blacks and Hispanics were less likely than whites to activate the account as well as to use it repeatedly. The racial and ethnic disparities remained in models that controlled for insurance status , language, age, and number of visits and of chronic conditions. This suggests that the racial disparity cannot be entirely attributable to selection on the part of clinicians but instead reflects in part structural factors facing patients (such as lack of computer access) or individual factors (such as low health literacy). A policy to reduce disparities in PHR usage should thus provide support for patients through all three stages; access to the portal, activation of the portal account, and portal use.

However, in our data, activating the account on the same day the access code was generated was associated with a lower likelihood of becoming a repeat user. During the analysis, we learned that several clinicians in the Bronx had been making concerted efforts to provide access codes and activate portal accounts during the office

visit; our findings suggest that the patients so selected did not uniformly become regular portal users. We also found that a diagnosis of depression was associated with increased likelihood of receiving a portal access code, but not with likelihood of activating the account or becoming a repeat user; during the analysis, we learned that one mental health clinic had been making concerted efforts to provide portal access codes to patients.

The racial disparities appear smaller than those reported in other recent studies, although direct comparisons are challenging because each of these studies had different inclusion criteria and methods, and examined a different stage in the process. A study of patients participating in a cohort study at Kaiser Permanente Georgia focused on access to the portal account. In this cohort, 30% of the blacks registered for a portal account compared to 42% of the whites.[16] Hispanics were too rare to be analyzed. By contrast, at IFH, portal access codes were created for 16% of IFH's black patients, 18% of the white patients, and 15% of the Hispanic patients.

Two studies have examined use of portal accounts. In one among Cleveland Clinic patients who had registered for an electronic portal, black patients constituted 6% of portal users and 11% of registered nonusers; Hispanics were 2% of portal users and 1% of registered nonusers.[15] In a small study at a public HIV/AIDS clinic, nonwhites were 22% of users and 44% of nonusers with e-mail addresses; Hispanics were 15% of users and 26% of nonusers with e-mail addresses.[17] By contrast, at IFH, black patients constituted 15% of portal users and 18% of nonusers with accounts; Hispanics constituted 19% of portal users and 17% of nonusers with accounts.

Several explanations are possible for the smaller racial disparities evident in our data. This study was conducted several years after the Cleveland Clinic study, during which the "digital divide" between whites and blacks narrowed nationwide[8]; however, our data collection period overlaps with that of the San Francisco study, making a secular trend explanation less likely. The New York metropolitan population may have had better access to the Internet through public facilities such as libraries and community technology centers than populations in other regions. Finally, the Institute for Family Health has a strong organizational commitment to the care of underserved populations, which may have created a culture that promoted equity.

Not surprisingly, we found that patients who visited health centers more often were more likely to receive codes and activate

their accounts; this relationship persisted even in models that controlled for age and health status, as indicated by number of chronic conditions. Age, number of clinical visits, number of chronic conditions, and frequency of portal use were all correlated with each other. Hyperlipidemia and HIV/AIDS were the only chronic conditions associated with increased likelihood of receiving portal access, activating the account, and becoming a repeat user (although some of these associations missed statistical significance). Surveys and qualitative research have suggested that patients with chronic diseases have substantial information needs that could be met through an electronic portal, such as test results with explanatory information, personal history data, and secure messaging.[5,18,19] Portals have been used to screen patients for chronic conditions.[20] However, Weingart et al. reported that enrollees of an Internet portal had fewer medical problems than non-enrollees; enrollees were also more affluent and younger than non-enrollees.[21] In the HIV clinic study described above, portal users were as likely as nonusers to have a diagnosis of AIDS, but were more likely to be receiving antiretrovirals, to have undetectable viral load, and to have high CD4 counts.[17]

## Limitations and Strengths

Previous reports of disparities in portal usage have focused primarily on either portal registration[16,17] or upon use of the portal.[15] Our study differs from these by examining disparities in the likelihood of receiving a portal access code, activating the account, and repeatedly using the portal. In addition, previous reports have either been among insured patients[15,16] or among patients with a single chronic illness[17]; our study looks at the entire patient population of a community health center network. This study also extends previous work by reporting results in a large and racially, ethnically, and socioeconomically diverse population.

However, there are limits to what can be learned purely from quantitative data extracted from the portal and the EHR. Patient-reported data or geographic data could extend this work by examining patient-reported outcomes such as perceptions and satisfaction, as well as other predictors including education, literacy, employment status, neighborhood, and other socioeconomic indicators. Portal use has been associated with education level in a largely white population.[22]

Patient–provider relationships are another important factor that would be best studied through qualitative studies or surveys. For example, it is not clear to what extent patient use of a portal is intrinsically motivated and what extent it is the result of encouragement by providers. We have evidence that provider behavior varied, with only 65.8% of providers issuing codes to their patients, and a great amount of additional variability in the number of portal users per provider, with one quarter of providers issuing only one access code, and another quarter issuing 38 or more. However, we have no information about other provider factors including attitudes or beliefs, particularly their commitment to engaging patients through the portal. For most patients, providers are likely to be the ones who introduce them to the portal and interest them in its use, and changing provider behavior may be an effective way to increase patient engagement. On the other hand, some qualitative research has linked patient interest in portals with dissatisfaction with the patient–provider relationship.[18]

In either case, provider attitude and behavior are likely to be key factors for future research.

## CONCLUSIONS

A safety net provider achieved good early rates of adoption and usage for an electronic patient portal among a predominantly low-income patient population. Racial and economic disparities were evident at all stages of access to the portal, activation of portal accounts, and usage of accounts, but these disparities were smaller than those previously reported in other populations. Patients with chronic conditions were more likely to use the portal. In order to ensure that any benefits of patient portals accrue equitably to all patients, continued efforts will be needed to ensure that all patients receive access to portal accounts and receive adequate support to activate and use these accounts. These efforts might include: organizational policies to encourage health care providers to use and promote portals, to offer accounts to all patients, and to make particular outreach efforts to low-income and minority patients; public policies to increase access to computers and the Internet; partnerships in which health-care organizations help teach patients computer literacy skills; and interface redesign to improve portal usability and accessibility. Research in this domain should include qualitative and survey studies about patients' and providers' reasons for both using portals and not using them, as well as quantitative and mixed methods approaches to assess the impact of policies intended to reduce disparities in usage. Finally, researchers should continue to assess the potential impacts of portal usage on health outcomes, health-related knowledge, access to health care, and the quality, safety, and costs of care.

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