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Health Digital Inclusion and Patient-centered Care Readiness in the USA

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Abstract:

Patient-centered care is a relatively new form of healthcare that empowers people when they receive services, but patients must get ready for the active roles they are going to play in order to participate. Based on a literature review, this study conceptualizes that patient-centered care readiness has two basic capabilities: (1) health information access and (2) coordination and communication. The development of these capabilities, leading to the ultimate objective of patient choice and empowerment, depends on the status of health digital inclusion. To maximize the benefits of patient-centered care and reduce the risk of health disparity, it is necessary to assess the patient-centered care readiness of a population, especially to find out who is at a disadvantage. Using the 2009 U.S. National Health Interview Survey data, this study conducts logistic regression and classification tree analyses to predict the two capabilities with eleven physiological, population, socioeconomic, and healthcare-related variables. The results suggest that there is an uneven development of patient-centered care readiness in the country, especially for those who are socially and economically disadvantaged, such as minority people and senior citizens. The findings provide researchers and practitioners the insights on how to cross the gap and prepare the whole nation for the transition.

Keywords: patient-centered care readiness, health information access, coordination and communication, health digital inclusion, user demographics, classification tree

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I. INTRODUCTION

Patient-centered care and health information technology are the most important advents for ambulatory medicine as they greatly improve service quality [Ventres and Frankel, 2010]. The synergistic employment of both leads to the socio-technical environment that encourages personalized care and enhances collaborative decision-making involving both service providers and patients, but digital divide renders a significant proportion of the population unable to participate [Burstin, 2000]. To deal with such a health disparity, it is important to identify who is in danger of being excluded from patient-centered care in the digital age and address the issues that contribute to the gap [Roblin, Houston, Allison, Joski, and Becker, 2009].

The emergence of patient-centered care reflects the shift from the traditional physician-centered medicine to the consideration of patients' perspectives in terms of their wants, needs, and preferences [Laine and Davidoff, 1996]. For patients to be able to collaborate with physicians in the decision-making process, they must prepare for the new roles that they are to play. An important aspect is the use of various health information technology (HIT) applications for informational and communicative purposes [Calabretta, 2002]. However, people who are socioeconomically disadvantaged are less likely to use information technologies than are others [Hsieh, Rai, and Keil, 2008]. Thus, it is important to expand the technology-user base in the effort for digital inclusion in solving the problem of the digital divide [Selwyn and Facer, 2007; U.S. Department of Commerce, 2000; López, Green, Tan-McGrory, King, and Betancourt, 2011]. The research question of this study, therefore, is: How can people's readiness to participate in patient-centered care be enhanced through health digital inclusion?

Specifically, this study has two main objectives: (1) to understand the concept of patient-centered care readiness and its relationship to health digital inclusion, (2) to examine the current status of patient-centered care readiness in a population and identify who needs help. The empirical analysis and discussion of results will focus on the case of the United States as the country moves toward the vision of patient-centered care in 2020 [Davis, Schoenbaum, and Audet, 2005]; yet the digital divide in healthcare still presents a big concern [Jha, DesRoches, Shields, Miralles, Zheng, Rosenbaum, and Campbell, 2009].

II. CONCEPTUAL FRAMEWORK

There are quite a few definitions of patient-centered care, including the following one from Don Berwick [2009] (the former president of the Institute for Healthcare Improvement), which is relatively comprehensive: "The experience (to the extent the informed, individual patient desires it) of transparency, individualization, recognition, respect, dignity, and choice in all matters, without exception, related to one's person, circumstances, and relationships in health care" (p. w560). In addition to the attributes of patient-centered care, such as transparency, respect, and choice, this definition emphasizes the critical issue of social inclusion by including the phrase "without exception." If patient-centered care were offered to some patients but not the others, this serious social bias would compromise its original purpose. Digital inclusion, as an important aspect of social inclusion, may play an essential role in preparing people for participation in patient-centered care.

The rationale for patient-centered care lies in the fact that patients are often in a better position than physicians to understand what matters most in terms of their own health [Sepucha, Uzogarra, and O'Connor, 2008]. To collaborate with physicians in decision-making, patients need to be aware of their health issues and medical options and communicate effectively with physicians [Fernandopulle, Ferris, Epstein, McNeil, Newhouse, Pisano, and Blumenthal, 2003]. Such an empowerment of patients largely depends on the use of health information technologies [Demiris, Afrin, Speedie, Courtney, Sondhi, Vimarlund, Lovis, Goossen, and Lynch, 2008]. That is, how prepared people are to engage in this form of healthcare, or "patient-centered care readiness," is closely related to their access to relevant applications. Therefore, health digital inclusion lays the foundation of patient-centered care readiness, as shown in Figure 1.

So what exactly does health digital inclusion mean in the context of patient-centered care? In other words, what are the capabilities that the use of relevant health information technologies may endow on the next generation of patients? An examination of key principles of patient-centered care may pinpoint such capabilities. Bechtel and Ness [2010] suggested that this form of healthcare must provide patients with: (1) "whole-person" care, (2) coordination and communication, (3) patient support and empowerment, and (4) ready access. Similarly, the International Alliance of Patients' Organization sets out five principles of patient-centered healthcare in its *Declaration on Patient-*

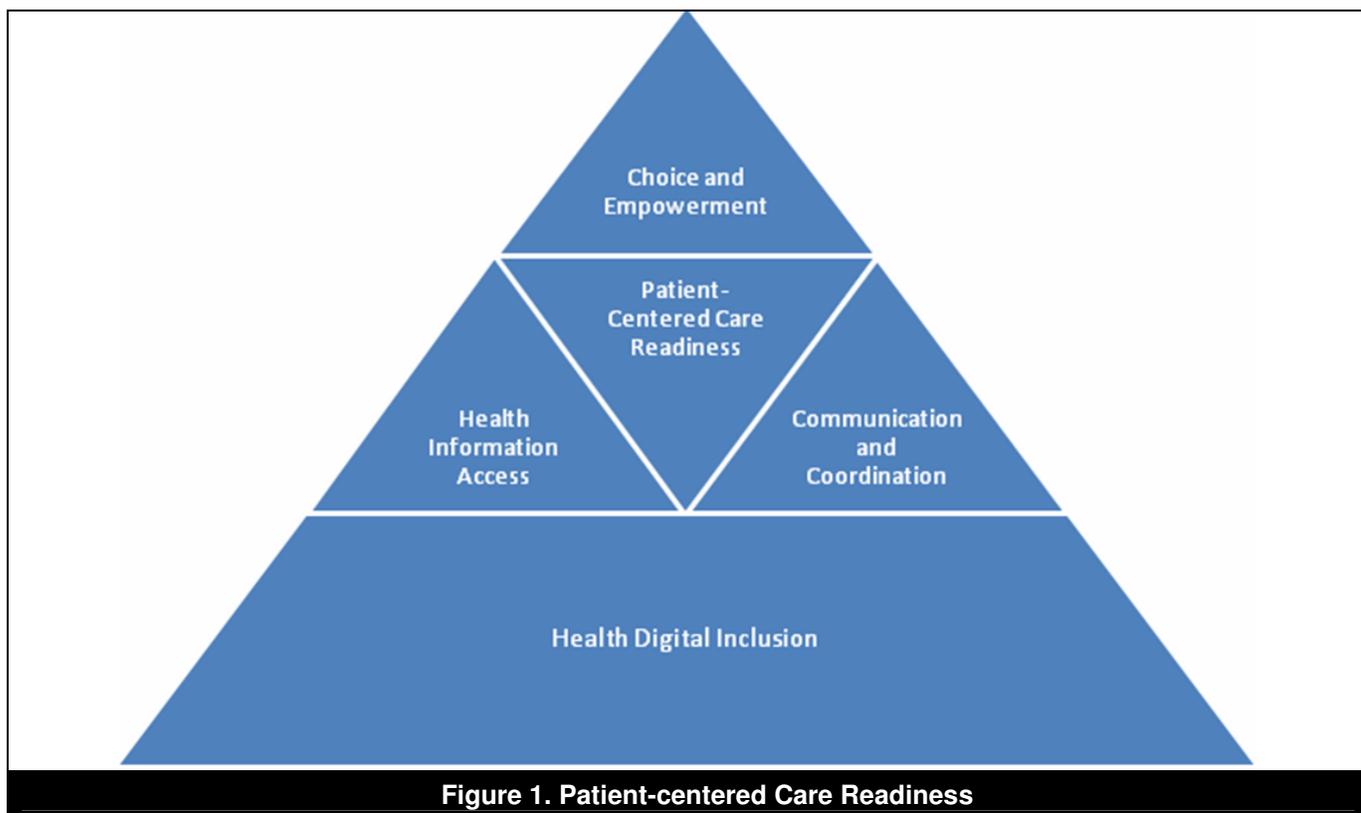


Figure 1. Patient-centered Care Readiness

centred Healthcare: (1) respect, (2) choice and empowerment, (3) patient involvement in health policy, (4) access and support, and (5) information [IAPO, 2006].

The principles imply the following capabilities of patients in patient-centered care: (1) health information access, (2) communication and coordination, (3) choice and empowerment. Among them, the last one is related to the objective of patient-centered care to give patients options and power. The awareness of different options in healthcare depends on access to health information, and having a voice in the decision-making process requires that patients be able to communicate and coordinate with service providers effectively [O'Connor, Llewellyn-Thomas, and Flood, 2004]. Thus the ultimate capability of choice and empowerment is built on the basic capabilities of health information access, as well as on communication and coordination—the two fundamental components of patient-centered care readiness.

The development of both informational and communicative capabilities requires the use of health information technologies. In particular, the Internet allows for average people to easily access health information and communicate with medical practitioners [Baker, Wagner, Singer, and Bundorf, 2003; Lewis and Behana, 2001; Wright and Bell, 2003]. The health information obtained from various online sources enables people to monitor health conditions, understand medical options, and improve their quality of life through suggested practices [Quintana, Feightner, Wathen, Sangster, and Marshall, 2001; Levy and Strombeck, 2002; Jadad, Haynes, Hunt, and Browman, 2000; Tay-Yap and Hawamdeh, 2001]. Patients can also communicate with physicians through electronic mail, Web messaging, and other applications [Liederman and Morefield, 2003; Neill, Mainous, Clark, and Hagen, 1994]. Effective patient–physician communication establishes common ground for collaborative decision-making [Stewart, Brown, Donner, McWhinney, Oates, Weston, and Jordan, 2000].

Therefore, health digital inclusion endows average people with the basic capabilities needed to engage in patient-centered care. Specifically, it allows average patients to obtain health information and to communicate easily with physicians so that they can participate in the decision-making processes related to their own health. Population-wise, the ready access to information and communication technologies facilitates the transition from traditional physician-centered medicine to new patient-centered care [Avison and Young, 2007].

III. PREVIOUS STUDIES ON HEALTH DIGITAL INCLUSION

The conceptual framework provides a guideline on the empirical assessment of patient-centered care readiness in a population. The assessment requires the selection of relevant explanatory variables and appropriate statistical techniques. Because of the close relationship between patient-centered care readiness and health digital inclusion,

the selection is based on a review of previous studies on digital divide in healthcare, the other side of the coin of digital inclusion. A search in major medical research databases, including PUBMED, MEDLINE, and EMBASE, with the keyword “digital divide” found ten studies on the U.S. population published after the year 2000. Table 1 lists the sample size, statistical method(s), and explanatory variables used in each study.

Table 1: Empirical Studies on Digital Divide in Healthcare

Publication	<i>n</i>	Methods	Target	Predictors
Brodie [2000]	1,506	<i>t</i> -test	Online health information	age*, income*, education*, race*
Baker, Wagner, Singer, and Budorf [2003]	4,764	Logistic regression	Online health information	age*, gender*, income, education*, location
Hesse, Nelson, Kreps, Croyle, Arora, Rimer, and Viswanath [2005]	6,369	Logistic regression	Online health information	age*, gender*, race*, education*, income
Hsu, Huang, Kinsman, Fireman, Miller, Selby, and Ortiz [2005]	3,482,152	Logistic regression	Online health information	age*, gender*, race/ethnicity*, primary care provider*, location*, insurance*
Bundorf, Wagner, Singer, and Baker [2006]	8,378	Logistic regression	Online health information	insurance*, location*, education*, income*, gender*, age*
Lorence, Park, and Fox [2006a]	4,227	χ^2 test & Logistic regression	Online health information	income*, race*
Lorence, Park, and Fox [2006b]	2,463	χ^2 test	Online health information	gender*, age*, education, race and ethnicity*, marital status*, income
Peña-Purcell [2008]	2,726	χ^2 test	Online health information	Hispanic*, gender, income*, education
Yamin, Emani, Williams, Lipsitz, Karson, Wald, and Bates [2011]	75,056	Logistic regression	Personal health record	race/ethnicity*, income*, insurance*, primary care provider*
Sarkar, Karter, Liu, Adler, Nguyen, López, and Schillinger [2011]	14,102	Logistic regression	Internet patient portal	age*, gender, race/ethnicity*, education*, employment*

* Identified as a significant factor in the study

The number of observations varies from 1.5 thousand to 3.5 million. Population-wise, the nature of the inquiry requires a relatively large sample size. The statistical methods used include logistic regression, chi-square test, and *t*-test. These are traditional generalized linear modeling (GLM) techniques based on variance estimates. Given the same variance, a larger sample size will lead to a smaller standard error, making it more likely to detect a difference. As a result, most of the variables used in the studies were found to be significant. However, statistical significance does not automatically imply practical significance, especially when the sample size is large. Even if each variable is important, none of the GLM methods are able to locate different groups of people across the digital divide with various combinations of multiple variables. Most studies adopt people’s access to online health information as the target variable. However, the latest two studies go beyond the traditional “information have versus have not” aspect of the digital divide in the use of Internet-based health applications, such as personal health record systems and patient portal sites [Yamin et al., 2011; Sarkar et al., 2011]. The use of different target variables reflects the ongoing evolution of the health digital inclusion concept in the new era of patient-centered care. Findings support the claim that the use of patient-oriented health applications does not depend on Internet access alone [Watson, Bell, Kvedar, and Grant, 2008].

The review also takes note of different types of demographic variables used in previous studies. Age and gender describe the physiological characteristics of respondents. Race, ethnicity, and location differentiate populations based on anthropological classification and geographical distribution. Marital status, education, employment, and income are the variables associated with the social and economic situations of each individual. Finally, primary care provider and insurance are healthcare variables that indicate whether each respondent has health insurance coverage and a place to go when sick. Thus, there are four major types of variables: physiological, population, socioeconomic, and healthcare.

Age and gender are two common physiological variables. On average, senior citizens use less information and communication technology (ICT) than others for health-related purposes [Voelker, 2005]. Specifically, the National Survey of Americans on Technology [Brodie et al., 2000] showed that people sixty and above were significantly different (less than half in percentage) from the rest of the population in terms of ICT usage (i.e., computer, email,

Internet, medical information). Various studies also found that males and females are different in their use of computers and the Internet (e.g., Ono and Zavodny, 2003). For health issues, women are more likely to use the Internet than men [Bundorf et al., 2006; Baker et al., 2003; Hesse et al., 2005; Hsu et al., 2005; Lorence, Park, and Fox, 2006b; Peña-Purcell, 2008].

All the studies focus on the U.S. population, and the population variables included race, ethnicity, and location. According to the OMB [2009] standard, race includes five major categories: White, Black/African American, American Indian/Alaska Native (AIAN), Asian, and Multiple Race, and ethnicity has two levels: Hispanic vs. non-Hispanic. As the two classifications have overlapping areas (especially White and Hispanic), both race and ethnicity are needed to describe a group. For instance, compared to other racial/ethnic groups, non-Hispanic White Americans lead in health-related Internet usage [Brodie, 2000; Hesse et al., 2005; Hsu et al., 2005; Lorence et al., 2006a, 2006b; Peña-Purcell, 2008]. In addition, location may also be relevant to health digital inclusion because of the uneven geographic distribution of Internet penetration [Spooner, 2003].

Marital status, income, education, and employment describe the socioeconomic situations of each respondent. The literature suggests that married couples are more likely to go online for health concerns than single people are [Lorence et al., 2006b]. People who have higher income and education levels are more likely to use health information technologies [Bundorf, 2006; Baker et al., 2003; Hesse et al., 2005; Peña-Purcell, 2008; Lorence et al., 2006a, 2006b; Hsu et al., 2005; Brodie, 2000]. Employment is a categorical variable that indicates whether an individual is employed or not. Like income and education, it has a positive effect on technology usage, as people in the workforce are in general economically settled and socially involved [Sarkar et al., 2011].

The variables related to healthcare include insurance and primary care provider. Insurance coverage largely determines whether an individual has a place to go when sick [Pauly and Pagán, 2007]. Furthermore, those who have primary healthcare providers are more likely to use the Internet for health-related purposes than others are [Hsu et al., 2005]. Before people go to see a doctor, they may search online to do a self-diagnosis [Wagner, Hibbard, Greenlick, and Kunkel 2001]; after they see a doctor, they may seek information to evaluate the quality of health services provided [Haas-Wilson, 2001].

IV. PATIENT-CENTERED CARE READINESS IN THE UNITED STATES

In the United States, patient-centered care and health information technology are two major components of the national strategy to improve the quality and efficiency of medical service [Thompson and Brailer, 2004]. This study examines the current status of patient-centered care readiness in the country from the angle of health digital inclusion based on the National Health Interview Survey (NHIS) data. NHIS is an annual nationwide survey conducted by the U.S. Census Bureau since 1957. Based on interviews with the Americans households sampled, the survey monitors the health conditions and practices of people in the country on a broad range of topics.

Variables

In 2009 (but not again in 2010), NHIS asked a new set of questions on the use of health information technologies, including Internet, email, electronic prescription, online appointment scheduling, and chat groups. Among other questions, two pertain to patient-centered care readiness. One asks whether the respondents “looked up health information on the Internet”; it indicates the basic capability of health information access. The other asks whether the respondents “communicated with healthcare provider by email,” and it indicates the basic capability of the person regarding communication and coordination. This study uses these two binary variables as the target variables.

The adult sample of 2009 NHIS dataset contains more than 500 variables. A population-wise analysis of patient-centered care readiness needs to include the demographic variables that may explain the individual differences in the use of relevant health information technologies. DeVoe, Wallace, and Fryer [2009] found that the demographics of patients are closely related to their behavior regarding online health information access as well as communication and coordination with healthcare providers. Thus, this study uses one set of demographic variables to predict two different target variables. Based on the aforementioned literature review, eleven physiological, population, socioeconomic, and healthcare variables were selected or recoded from the dataset. For instance, gender and age are the two physiological variables: the former is taken directly from the raw data, and the latter is a binary variable recoded from the original age variable using sixty as the cutoff.

The population variables include race, ethnicity, and region. Like most previous studies, the racial and ethnic classifications are based on the OMB [2000] standard. Depending on where the respondents live, the region variable has four values: Northeast, Midwest, West, and South. Compared with other location-related classifications (e.g., metropolitan vs. rural), this variable is free of direct socioeconomic implications. There are three socioeconomic variables in the dataset: marital status, employment, and homelessness. All being binary variables, their values

depend on whether or not a respondent is married, has or is looking for a job, and has spent twenty-four hours or more living on the streets, in a shelter, or in jail/prison. The last variable is included in this study because homeless people typically have limited Internet access [Hersberger, 2002–2003].

Healthcare variables are related to respondents' ability to access healthcare services. The first variable, primary care provider, asks respondents whether they "have a place to go when sick." Though the dataset does not contain the variable "insurance," the lack of access to primary healthcare providers is mainly due to being uninsured [Pauly and Pagán, 2007]. The next variable, "transportation," measures whether the "lack of transportation" prevents a respondent from going to healthcare services. The last variable, "affordability," asks respondents whether "affordability is major concern." The inclusion of the last two variables has no direct literature support, but researchers found that people having higher income and/or living in metropolitan areas are more likely to use IT applications for health-related purposes than others [Bundorf et al., 2006; Baker et al., 2003]. Income is related to the affordability issue, and the residents of big cities have generally convenient physical access to healthcare services in terms of distance and means. Thus affordability and transportation may be relevant to patient-centered care readiness.

Statistical Analyses

The NHIS dataset contains 27,731 observations. Similar to previous studies, the sample size is relatively large. It leads to high statistical power for traditional variance-based methods. Nevertheless, the commonly-used logistic regression analysis makes it easy to directly compare the observed significance levels of explanatory variables across two target variables in this study. The results may tell how well the demographic variables selected based on the literature review can explain the development of patient-centered care readiness. If a variable is found relevant to at least one of the informational and communicative capabilities, it will enter further classification tree analyses to identify specific subpopulations at different levels of development.

Classification tree method is a data mining technique that generates a hierarchy of rules, each associated with an explanatory variable, to classify observations into relatively homogenous groups that are as heterogeneous as possible from each other in terms of target responses. Specifically, this study uses the Chi-square Automatic Interaction Detection (CHAID) algorithm to identify the demographic groups who are distinct in their informational and communicative capabilities based on the statistical interactions between each target variable and other physiological, population, socioeconomic, and healthcare variables. The classification trees obtained disclose where and how wide the gap is in the development of patient-centered care readiness.

Finally, a split-sample validation will assess the stability of the classification trees obtained. The procedure randomly separates the full sample into two half samples. If the classification trees obtained are about the same, it suggests that the findings are reliable and generalizable.

Results

Table 2 gives the frequency distribution of each variable used in the study. About half of the participants had used the Internet to search for health information, but only a little over 5 percent had emailed healthcare providers. Gender distribution was mostly balanced, with slightly more women than men. About 30 percent of respondents were sixty or older. Among the racial groups, about three quarters of participants were White Americans, over 16 percent were Black/African Americans, about 6 percent were Asian Americans, and the rest were American Indians and Alaska Natives (AIAN), multiple races, or race groups not releasable. Close to one fifth of the participants (5,165) had Hispanic ethnic background, and among them, over 90 percent (4,656) were classified as White. The geographic distribution of participants reflected that of the whole population, according to U.S. Census Bureau (www.census.gov): the South has the largest proportion, followed by the West and Midwest, and finally the Northeast. About half of the participants were married at the time of the survey, and about two-thirds were working or looking for jobs. Almost 7 percent spent more than twenty-four hours during the previous twelve months living on the streets or in a shelter or jail/prison. More than 80 percent of the participants had a place to go when they were sick. Though the lack of transportation to nearby healthcare services was not a concern for most people (<2.5 percent), affordability still posed an issue for more than one-fifth of respondents.

The next logistic regression analysis showed that all eleven demographic variables were significant predictors of health information access, but four of them, including marital status, homelessness, transportation, and affordability, did not explain the other target variable—communication and coordination—as well. The Wald statistics showed that most variables exhibited better explanatory power on the informational capability than the communicative capability of patient-centered care readiness. This difference may be due to the fact that the first target variable had more balanced responses than the second (i.e., 47.64 percent vs. 5.36 percent). The odds ratios indicated that the

directions of effects (i.e., whether Exp(B) is greater or smaller than one) were consistent between two target variables, except in the South region.

For both target variables, the detailed results were mostly consistent with previous studies on health digital inclusion. In terms of gender and age, males or people over sixty were less likely to seek health information online or to email healthcare providers than women or younger people. Compared to White Americans, other racial groups lagged behind in terms of Internet and email usage for health-related purposes. Also, Hispanics were relatively underserved compared to non-Hispanics. Geographically, the West took the lead in both aspects, followed by the South for health information access and the Northeast for communication and coordination, and at the bottom was the Midwest. Participants who were in better socioeconomic conditions (with “employment”) and had easier access to healthcare services (with “primary care provider”) were more likely to use the relevant health information technologies.

Table 2: Frequency and Logistic Regression Analyses

Category	Variable	Yes%	Informational		Communicative	
			Wald	Exp(B)	Wald	Exp(B)
Patient-centered care readiness	Informational capability (looked up health info on the Internet?)	47.64	—	—	—	—
	Communicative capability (emailed health care providers?)	5.36	—	—	—	—
Physiological	Gender (male?)	44.21	287.77**	0.63	16.84**	0.79
	Age (60 or above?)	27.20	889.53**	0.35	20.70**	0.70
Population	Race	—	546.07**	—	42.31**	—
	– White (baseline)	74.94	—	—	—	—
	– Black/African American	16.48	473.73**	0.44	38.61**	0.57
	– Asian	5.94	107.44**	0.56	3.14*	0.83
	– American Indian/Alaska Native	0.89	14.13**	0.57	2.08	0.59
	– Multiple race	1.56	0.09	0.97	.78	0.59
	– Race group not releasable	0.19	2.43	0.63	.13	0.93
	Ethnicity (Hispanic?)	18.63	1372.60**	0.25	142.61**	0.32
	Region	—	72.15**	—	185.46**	—
	– Northeast (baseline)	16.60	—	—	—	—
	– Midwest	22.56	0.40	0.97	15.03**	0.70
	– South	36.59	12.37**	1.15	5.97**	0.82
	– West	24.25	42.11**	1.32	50.82**	1.78
Socio-economic	Marital Status (married?)	50.60	109.71**	1.32	2.28	1.09
	Employment (working/looking for job?)	64.59	488.06**	2.02	92.21**	2.05
	Homelessness (living in street/shelter/jail?)	6.76	15.39**	0.81	1.59	0.85
Healthcare	Primary care provider (is there one?)	83.33	279.80**	1.86	64.01**	2.14
	Transportation (lacking?)	2.48	14.52**	0.71	1.49	0.76
	Affordability (is a major concern?)	21.32	11.89**	1.12	1.29	1.08

Parentheses that contain a question mark indicate that the variable has two values: 1 if the answer is yes and 0 if the answer is no.
 The degree-of-freedom (*df*) of Wald statistic is equal to 1 except for Race (*df* = 5) and Region (*df* = 3).
 ** – Significant at 0.01 level; * – Significant at 0.1 level

Figure 2 shows the classification tree targeting the informational capability. The first split of the sample occurred at the variable of age: the participants who were sixty or older had a much lower rate of Internet usage for health-related purposes than those below sixty (29.5 percent vs. 54.4 percent). Among younger people, ethnicity made the next split: the ratio of the usage rate between non-Hispanics and Hispanics was almost two to one (60.6 percent vs. 32.2 percent). Within the non-Hispanic group, White Americans took the lead (66.3 percent), followed by Asian Americans and multiple races (54.8 percent) and Black/African Americans and American Indians/Alaska Natives (44.9 percent). Among Hispanics, those who had a place to go when they were sick were more likely to seek health information online than were those who did not (37.4 percent vs. 20.5 percent). For the participants over the age of sixty, whether they were working or looking for a job made a big difference (47.4 percent vs. 23.3 percent). Compared with other senior workers, however, Hispanics were worse off (19.2 percent vs. 50.4 percent). Finally, the group least penetrated by the Internet were retired people older than sixty who were also single (16.5 percent), in contrast to those who were married (31.8 percent).

Similarly, Figure 3 shows the classification tree targeting the communicative capability. Employment was the most important variable in this case: people in the workforce were twice as likely to email healthcare providers as those who were not working (6.6 percent vs. 3.1 percent). Within the workforce group, ethnic again made the next split:

non-Hispanics led Hispanics by the ratio of five to two (7.5 percent vs. 3.0 percent). Among working Hispanics, those who had places to go when they were sick were four times more likely to communicate with healthcare providers than those who didn't (3.9 percent vs. 1.0 percent). Among working non-Hispanics, regional difference was the most salient: the West took the lead (12.7 percent), followed by the Northeast (7.8 percent) and the South and Midwest (5.7 percent). For all the people not in the workforce, geographic distributions still mattered: those in the West were twice as likely as those in other regions to email healthcare providers (5.1 percent vs. 2.5 percent). Even in the West, retired Hispanics lagged far behind non-Hispanics (1.8 percent vs. 6.4 percent). For non-working people in the other regions, those who were over sixty were less likely to use the communicative tool for their health issues than younger people were (1.5 percent vs. 3.9 percent).

Table 3 shows the cross-validation result by comparing the leaf nodes (i.e., the final groups in a classification tree) obtained with the whole sample and half testing sample. The target responses and proportions of each node are mostly consistent between two samples, suggesting that the classification trees obtained are quite robust against sampling errors. Thus there is supporting evidence for the reliability and generalizability of the findings.

V. DISCUSSION

The results provide an initial evaluation of patient-centered care readiness in the U.S. from the perspective of health digital inclusion. First of all, the analyses show that the current development is out of balance in terms of the two basic capabilities. Almost half of the respondents searched health information on the Internet, but only about 5 percent emailed healthcare providers. Compared with the capability of health information access, therefore, there is still a long way to go for the capability of communication and coordination. This issue is more pertinent to healthcare providers than patients: providers need to open more accessible channels for patients to discuss health-related issues with them.

The logistic regression analysis confirms the relevance of all the explanatory variables to patient-centered care readiness. However, their effects vary more or less across two target variables, leading to some interesting insights. Unlike the other variables, in particular, region is a more salient predictor of communication and coordination than is health information access. A closer look indicates that the West leads the rest of the country in both aspects of patient-centered care readiness. It is not a coincidence that the region has seen more active development and use of personal health record (PHR) systems than the others. For instance, Kaiser Permanente®, a major healthcare provider in the western states, including California, Colorado, Hawaii, Oregon, and Washington, implemented a successful PHP platform called *My Health Manager* for patients to monitor their health conditions and contact physicians directly [Silvestre, Sue, and Allen, 2009]. The salience of the variable suggests that technology investment is very important for the development of patient-centered care readiness at the regional level.

Compared with the logistic regression method that focuses on the statistical significance of individual variables, the classification tree method is able to identify specific demographic groups based on the relative importance of multiple variables. The results enable researchers and practitioners to find out which groups are relatively vulnerable in the digital era of healthcare. If they focus on one variable at a time, the conclusion may be incomplete or even misleading. For example, the logistic regression results indicated that the variable "race" was highly significant and "White Americans" led the other racial groups in terms of patient-centered care readiness. Over 90 percent of Hispanics are classified as White Americans, but they are actually at the disadvantage. In the classification tree targeting health information access, the ethnicity variable splits the sample at a higher level than the race variable, distinguishing between Hispanics and non-Hispanic White Americans.

For both aspects of patient-centered care readiness, it is minority people and those who are socially and economically disadvantaged that need the most help. Among the nine leaf nodes in the classification tree for either one of the target variables, they comprised the last three that had the lowest average responses (see Table 3). In particular, Hispanics, especially those who do not have a place to go when they are sick, are generally not ready for patient-centered care. Also, people who are senior in age and/or not in the workforce are less prepared for the new trend of healthcare.

Previous studies of digital divide suggest that socioeconomic situations of people such as income and education are the covariates that explain their access to online health information. In 2009, 19.3 percent of Black/African Americans and 13.2 percent Hispanics had higher education degrees, compared to the national average of 29.5 percent [U.S. Census Bureau, 2011]. The average annual income was \$49,777 for U.S. households, and it was \$32,584 for Black households and \$38,039 for Hispanic households. The socioeconomic gap across races and ethnicities in the U.S. contributes to the digital divide [Talukdar and Gauri, 2011]. Despite the absence of the

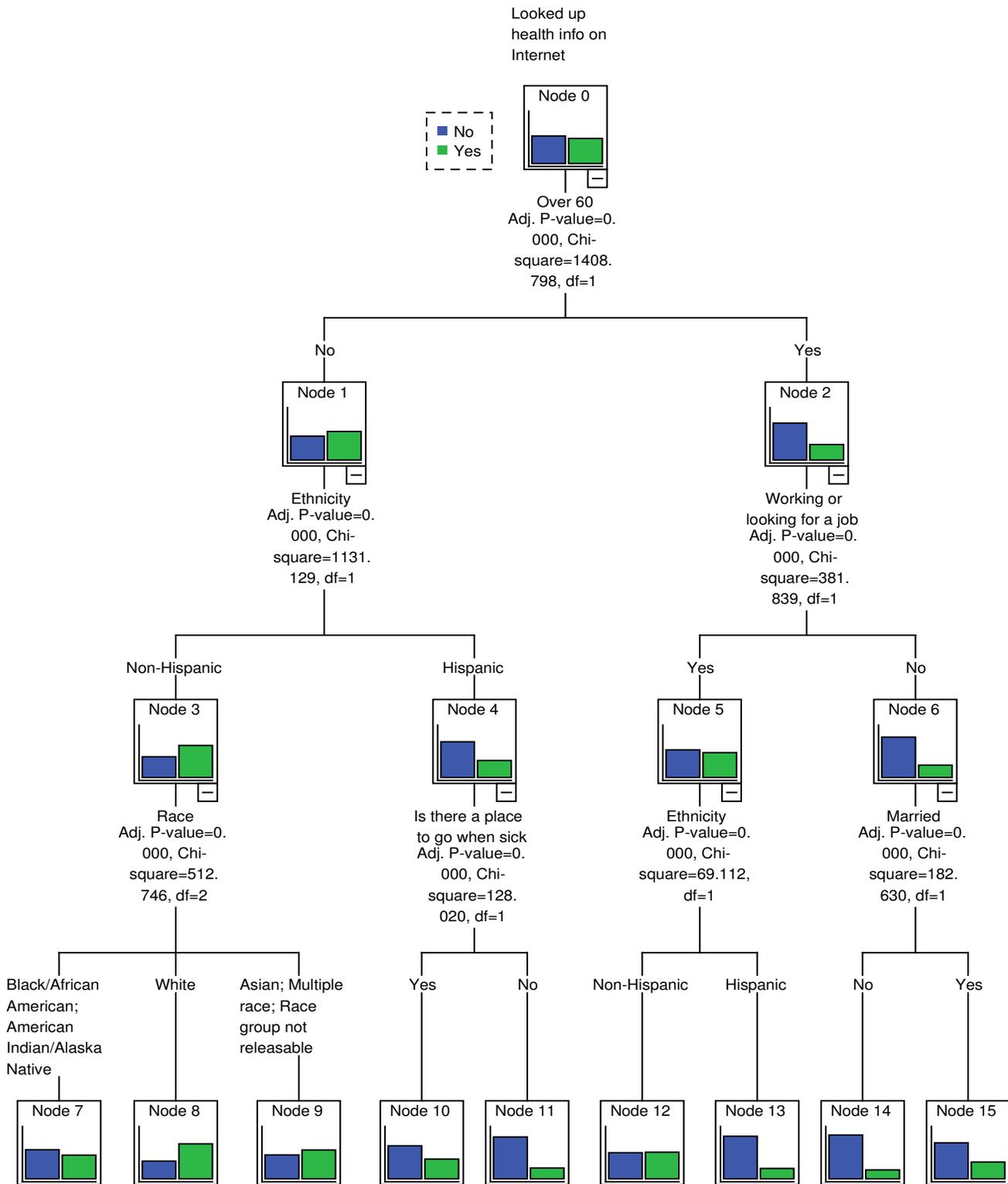


Figure 2. Classification Tree of Health Information Access

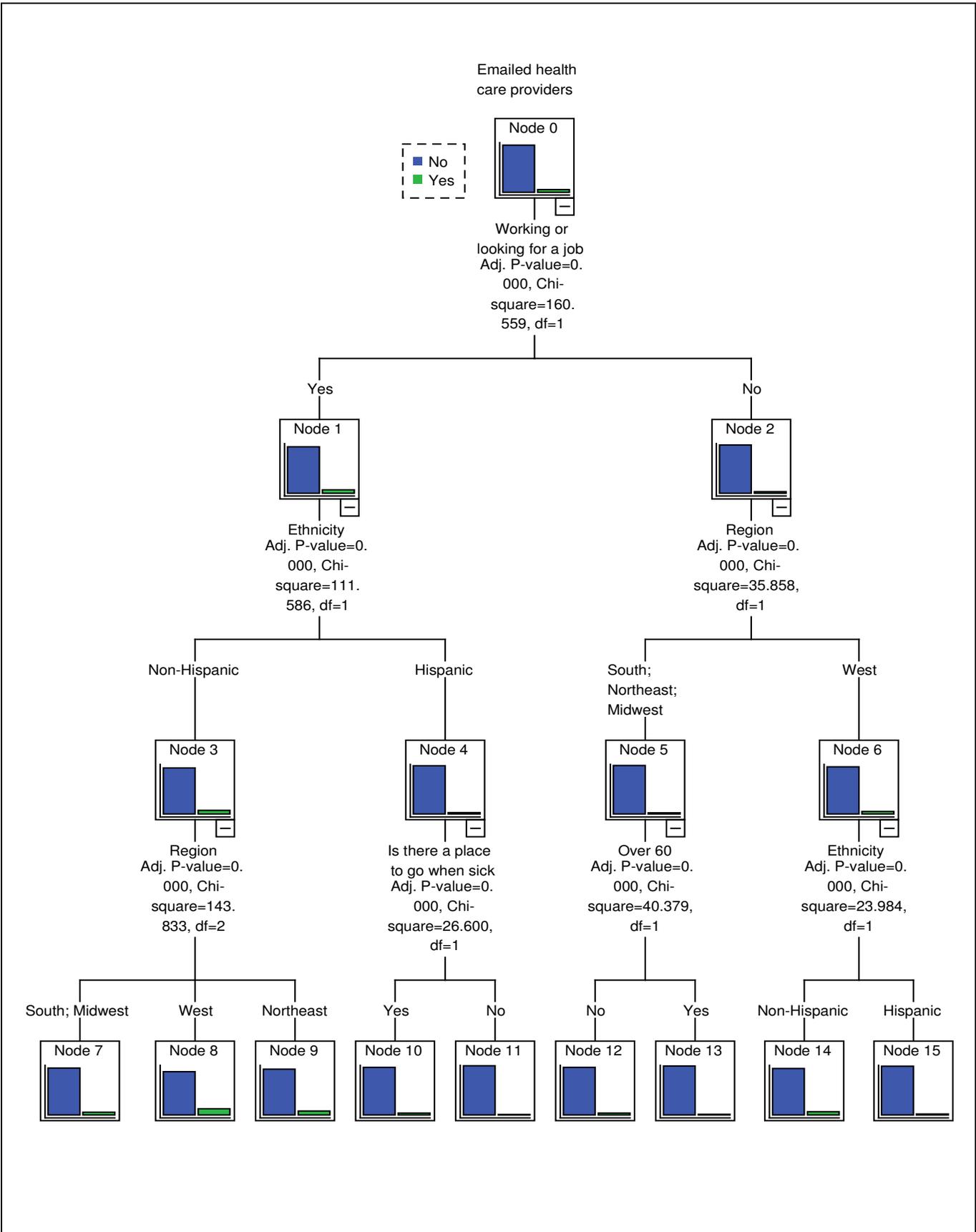


Figure 3. Classification Tree of Communication and Coordination

Table 3: Demographics of Patient-centered Care Readiness

Target	Node description	Node	Whole sample		Test sample	
			<i>n</i>	Yes%	<i>n</i>	Yes%
Health information access	Under 60 Non-Hispanic White	8	10,883	66.33	5,488	66.29
	Under 60 Asian	9	1,520	54.80	754	52.92
	Over 60 Working Non-Hispanic	12	1,743	50.37	891	50.51
	Under 60 Black American/AIAN	7	3,388	44.92	1,700	45.06
	Under 60 Hispanic with Primary Care	10	3,046	37.36	1,480	35.47
	Over 60 Retired and Married	15	2,506	31.80	1,255	32.59
	Under 60 Hispanic without Primary Care	11	1,351	20.50	647	21.33
	Over 60 Working Hispanic	13	182	19.23	90	16.67
Communication and coordination	Over 60 Retired and Single	14	3,112	16.45	1,554	16.47
	Working Non-Hispanic in West	8	2,960	12.67	1,482	12.21
	Working Non-Hispanic in Northeast	9	2,441	7.82	1,242	7.73
	Retired Non-Hispanic in West	14	1,695	6.37	818	5.26
	Working Non-Hispanic in South & Midwest	7	8,945	5.66	4,392	5.46
	Working Hispanic with Primary Care	10	2,408	3.90	1,207	3.81
	Under 60 Retired in South, Northeast & Midwest	12	3,142	3.88	1,574	3.56
	Retired Hispanic in West	15	620	1.77	311	2.57
Over 60 Retired in South, Northeast, & Midwest	13	4,362	1.54	2,183	1.37	
Working Hispanic without Primary Care	11	1,158	1.04	578	1.04	

variables “income” and “education” in the NHIS dataset, the variables “race” and “ethnicity” account for the disparity in them to a large extent. This explains why the variable “affordability is an issue” does not show up in the classification trees, as the two variables may have explained most of its influence.

Among the minorities, Hispanics face the challenge of being excluded from patient-centered care even more than others. The results indicate that the lack of access to primary care providers (corresponding to the question “Is there a place to go when sick”) concerns the Hispanic population in particular. Among the respondents in the sample of this study, 1,351 out of 4,397 Hispanics who are under sixty cannot get primary care. The ratio is consistent with the fact that about one-third of Hispanics do not have health insurance coverage [DeNavas-Walt, Proctor, and Smith, 2010]. Many Hispanics are not ready for patient-centered care, as they are unable to obtain regular medical services. This issue is prominent for the Hispanic population because around 40 percent are immigrants, in comparison to 8 percent for non-Hispanics [Grieco, 2010]. Many immigrants are uninsured and cannot afford healthcare.

VI. LIMITATIONS AND IMPLICATIONS

The main limitation of this study is in the lack of control on the variables used in the empirical assessment of patient-centered care readiness due to the secondary nature of the data. From the NHIS survey questionnaire, this study uses the items “looked up health information on the Internet” as the proxy for health information access and “emailed healthcare providers” as the proxy for communication and coordination. In the NHIS 2009 dataset, they are the two items closely related to the informational and communicative capabilities. However, each gives only a partial picture of one capability. Health information access includes two aspects: the access to general disease information and personal health information. The first item does not ask which types of information respondents look for, and they may answer yes if either of the conditions is met. As general disease information is much more accessible, their responses are more likely to indicate the first aspect than the second. For communication and coordination, though, email is a common tool, there are other tools available or emerging, such as telephone, text messaging, and social media. Thus neither target variable can completely capture the development of each capability. NHIS did not collect the responses on health information technologies again in 2010, and it is hoped that the updated questions used later will provide further insights.

Despite the limitations, this study has several important implications. First, the conceptual framework unveils the relationship between patient-centered care and health digital inclusion. In particular, it examines the capabilities required of new-generation patients in terms of patient-centered care readiness: health information access, communication and coordination, and choice and empowerment. The first two capabilities are the necessary conditions for the third. Patients cannot make meaningful choices unless they are aware of the options through health information access. Also, they are not going to participate in the decision-making process without the ability to communicate and coordinate with healthcare providers. Thus the informational and communicative capabilities are fundamental to patient-centered care, and their development depends on the population-wise penetration of health

information technologies. This framework gives guidance regarding the empirical assessment of patient-centered care readiness from the angle of health digital inclusion.

The findings based on the U.S. National Health Interview Survey provide useful insights on how to enhance patient-centered care readiness by promoting health digital inclusion. The results indicate that the development of informational and communicative capabilities is largely unbalanced due to physiological, population, socioeconomic, and healthcare factors. Though these demographic factors are directly related to patients, the findings have implications that are more pertinent to other stakeholders of healthcare. Specifically, the promotion of patient-centered care readiness demands a collaborative effort involving policymakers, service providers, and community workers.

For policymakers, an important issue is how to enhance people's access to health information technologies and healthcare services. The results indicate that minority people, senior citizens, and/or those who are socioeconomically disadvantaged do not use health information technologies as much as others. Also, the salience of the variable "primary care provider" suggests that people with limited access to healthcare services are likely to be marginalized in the health digital inclusion. Therefore, for people who are at a disadvantage, enhancing their access to both health information technologies and healthcare services is essential to the balanced development of patient-centered care readiness.

The lack of financial resources and/or basic skills is the main hindrance to access. To mitigate the problem, policy makers need to promote economic and human development at the federal, state, and local levels. In this study, the variable employment is a salient predictor of both target variables. People who are in the workforce are likely to get insured and trained and more likely to be able to afford the medical and informational services. During the current economic recession, however, minority people suffer more than others: in 2009, the unemployment rate was 14.8 percent for Black/African Americans and 12.1 percent for Hispanics, compared to the national average of 9.3 percent [U.S. Department of Labor, 2010]. The widening socioeconomic gap may weaken the effort of health digital inclusion and compromise the development of patient-centered care readiness unless effective measures are taken. Increasing the population coverage of medical insurance gives a quick solution, whereas providing average people with more job and education opportunities yields a long-term effect.

On the supply side of patient-centered care, service providers include all the professionals who render medical and informational services to patients. The findings of this study suggest that they may enhance the development of patient-centered care readiness by addressing people's health-related informational and communicative needs. As mentioned previously, physicians shall provide patients more accessible channels for communicating with them. For instance, many people today do not have computers and/or Internet access at home, but they do have cell phones. Healthcare providers can open cellular communication channels, such as short text messaging, for them.

Also, developers may customize health information services for different groups of people. For instance, health-related websites can provide the content in both English and Spanish to Hispanic users. Another example is the high rate of diabetes in the Black/African American and Hispanic populations.¹ For disease prevention and control, health information providers may tailor the services (e.g., diet plans) to different cultural backgrounds.

To enhance digital inclusion at the community level, practitioners may provide necessary facilities and educational programs to help local residents gain access to healthcare services and information technologies. Such an initiative is particularly effective for the communities that are relatively underdeveloped and/or underserved [Sipior, Ward, Volonino, and Marzec, 2004]. For instance, hand-on training sessions can help new immigrants in certain areas get familiar with medical systems and health information technologies. Regardless of race and ethnicity, senior citizens, especially those who are single, are in the most need of personal attention and help. Community workers can give them the assistance needed to use health information technologies, such as the demonstration of what they can do with the technologies for health improvement through family visits.

VII. CONCLUSION

This study aims to understand and evaluate patient-centered care readiness from the perspective of health digital inclusion. The review of literature leads to the development of a conceptual framework as well as identification of target and explanatory variables. Using the NHIS data, it assesses the current status of patient-centered readiness in the U.S. population with logistical regression and classification tree methods. The analyses yield the taxonomy of

¹ According to the National Diabetes Information Clearinghouse under the National Institute of Health, 11.8 percent of Black/African Americans and 10.4 percent of Hispanics have been diagnosed with diabetes (<http://www.diabetes.niddk.nih.gov/dm/pubs/statistics/>).

subpopulations at different levels of patient-centered care readiness. The findings allow researchers and practitioners to gauge how wide the gap is and to find out who needs help.

The accuracy of assessment largely depends on the measurement validity of dependent variables related to the basic capabilities of patient-centered care readiness. As mentioned previously, the current measures of health information access as well as communication and coordination have several issues. In future studies, researchers may refine the measures for better assessment. In addition, the empirical examination focuses on the single case of the U.S. due to data availability. The framework and methodology can apply to other countries once observations are available. The international perspective obtained will yield insights on how to enhance the balanced global development of patient-centered care readiness.

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