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Assessing electronic personal health information use: An update on progress toward healthy people 2020 objectives

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ABSTRACT

Objective: To assess progress toward Healthy People 2020 health information technology objectives using nationally representative data.
Methods: We used data from six administrations (2003–2017) of the Health Information National Trends Survey (HINTS) to examine trends in the proportion of Americans who manage electronic Personal Health Information (ePHI) and email their healthcare providers. Two targets were evaluated: (1) a goal to exceed 15.7% of the general population for accessing ePHI (10% improvement), and (2) a goal to exceed 15% for communicating with health providers (10% improvement). Analyses included bivariate and multivariable logistic regression models, including assessing predicted marginal for key sociodemographic variables to explain observed digital divides in health information technology use over time.
Results: Self-reported management of ePHI online significantly increased between 2008 and 2017 from 14.2% to 70.9% ($p < 0.001$; HP2020 target = 15.7% by 2020). Use of email to connect with healthcare providers also significantly increased, from 7.0% in 2003 to 41.1% in 2017 ($p < 0.001$; HP2020 target = 15.0% by 2020). Multivariable regression revealed significant differences by sex, age, race/ethnicity (ePHI only), education, income, and geography over time.
Conclusions: Targets set forth in HP2020 were exceeded for these health information technology objectives. Though an increase in adoption of these tools was seen across all sociodemographic categories, disparities persist and have even widened for certain groups. As efforts move forward to set targets for HP2030, the persistence of the digital divide amongst these groups should be considered.

Introduction

Every decade, the United States Department of Health and Human Services (DHHS) tasks its Office of Disease Prevention and Health Promotion (ODPHP) with creating objectives for a program known as "Healthy People" (www.healthypeople.gov) [1,2]. Objectives of this program are aimed at improving and tracking progress in the nation's overall health. One of the broader topics included in Healthy People 2020 (HP2020) was "Health Communication and Health Information Technology" (HC/HIT); objectives within this topic aim to expand access to and use of HC/HIT tools for all citizens with the ultimate goal of improving health outcomes and moving toward achieving health equity.

Within the HC/HIT HP2020 topic of "increas[ing] the number of persons who use electronic personal health management tools" are two key objectives. The first is to "increase the proportion of persons who use the internet to keep track of personal health information, such as care received, test results, or upcoming medical appointments" by 10% (from 14.3% in 2008 to 15.7% by 2020) [2]. The second is to "increase the proportion of persons who use the internet to communicate with their health provider" by 10% (from 13.6% in 2008 to 15.0% by 2020) [2]. These objectives are reflective of the overall public and government interest in utilizing HIT for management of their own health and medical care in the

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Table 1
Details of the 6 survey administrations of HINTS between 2003 and 2017 utilized in these analyses; expanded from *Serrano* et al. [7].

	HINTS 1 (2003)	HINTS 2 (2005)	HINTS 3 (2008)	HINTS 4 Cycle 1 (2011)	HINTS 4 Cycle 3 (2013)	HINTS 5 Cycle 1 (2017)
Survey period	Oct 2002–Apr 2003	Feb 2005–Aug 2005	Jan 2008–May 2008	Oct 2011–Jan 2012	Sep 2013–Dec 2013	Jan 2017–Mar 2017
Number of respondents	6369	5586	Mail: 3582 RDD: 4092	3959	3185	3335
Survey mode	RDD*	RDD	Mail and RDD	Mail	Mail	Mail
Response rate	33.1%	20.8%	Mail: 40.0%; RDD: 24.2%	36.7%	35.2%	32.4%

* RDD = Random Digit Dialing.

early 2000s, as evidenced by the initial Meaningful Use metrics set forth in the 2009 Health Information Technology for Economic and Clinical Health (HITECH) Act. [3]

In putting forth these objectives, there is a need to evaluate progress toward the stated goals. For these HC/HIT objectives, the ODPHP worked in collaboration with the National Cancer Institute (NCI) to include specific items in the regularly fielded Health Information National Trends Survey (HINTS) to monitor progress toward the target percentages [4,5]. Utilization of such a nationally representative survey not only affords the opportunity to monitor progress toward the targets set by ODPHP, but also to evaluate where a digital divide may exist with regard to these HC/HIT tools and whether such a divide is growing or shrinking over time. Sociodemographic characteristics shown to be associated with disparities in access to and use of HIT tools have included sex, race/ethnicity, education, and income. Specifically, prior work has shown that those who use HIT tools tend to be female, aged 18–34, and non-Hispanic white. Users also have at least some college education and incomes greater than $70,000 per year [6–9]. Furthermore, there is a growing interest in the digital divide between urban and rural residents regarding health information technologies; especially as telemedicine continues to be hailed as a potential access solution for those residing in remote areas of the United States [10–12]. Exact details regarding hypothesized differences in usage of HIT tools between rural and urban residents have only begun to be examined; however, recent research shows that rural residents seem to use ePHI tools less than their urban counterparts [10].

As we near 2020, there is a need to assess the current state of progress toward the HP2020 HC/HIT objectives and targets. In a previous report, data used from HINTS administrations through 2013 indicated that the targets set forth in HP2020 had already been exceeded. Here, we update the previous analyses with data from the 2017 HINTS survey administration in the hopes of helping to inform development of objectives and associated targets for the next iteration of the Healthy People program, Healthy People 2030, and to provide additional information about gaps and inequalities in HIT use [6]. We include analyses examining trends of use of electronic Personal Health Information (ePHI) tools and electronic communication with providers over time with a focus on key sociodemographic variables, including age, sex, race/ethnicity, education and income. Additionally, we include an examination of rural versus urban differences in utilization of these tools, which was not examined in the previous report.

Methods

Survey population and data collection

Data from six HINTS administrations were merged for these analyses; details for each of these survey administrations can be found in Table 1. Briefly, HINTS is a nationally-representative cross-sectional survey of US adults that collects data on a broad range of health – and cancer-related topics, including use of health information technologies and communication with healthcare providers. Details on sampling, methods, and response rates have been published elsewhere [4,13,14].

For this study, we conducted a complete case analysis; therefore, sample sizes vary between the total number of respondents to HINTS and those who completed all the dependent and independent variable items. For example, those who responded earlier in the survey that they did not regularly use the internet were not subsequently asked whether they use the internet to manage ePHI or communicate with their provider. For additional details, please see the corresponding methodology reports for each survey administration (www.hints.cancer.gov).

Dependent variables

The first outcome variable of interest was whether individuals had managed their own ePHI online. The survey item used in the 2008, 2011, and 2013 administration of HINTS was: “In the last 12 months, have you used the internet to keep track of personal health information, such as care received, test results, or upcoming medical appointments?” In the 2017 survey administration, the NCI collaborated with the Office of the National Coordinator for Health Information Technology (ONC) to collect more granular data on the usage of ePHI; namely, to identify the specific tasks that were being done within an individual’s electronic health record (EHR). To that end, this update required that multiple items be combined into a new variable that would be comparable with the original question in previous administrations. Therefore, any respondent who replied yes to at least one of the following items from the 2017 survey was classified as having managed their ePHI online: 1) “In the past 12 months, have you used a computer, smartphone, or other electronic means to do any of the following… Made appointments with a health care provider?”; 2) “… Track health care charges and costs?”; 3) “… Filled out forms or paperwork related to your health care? ”; and 4) “… Look up test results?”. Respondents who replied “no” to all of these items were classified as not having managed their ePHI online.

For this outcome, those asked these items also change between earlier survey administrations and the 2017 survey. Prior to 2017, the question was asked of any respondent who said in an earlier item that they had regular internet access; in 2017, it was only asked of those who said that they had regular internet access AND access to their electronic health records.

The second outcome of interest was whether respondents had communicated with their healthcare provider online via email or secure messaging. The wording for the item in the 2003, 2005, 2008, 2011, and 2013 HINTS administrations was as follows: “In the last 12 months, have you used e-mail or the internet to communicate with a doctor or doctor’s office?” Again, due to the collaboration with the ONC for the 2017 HINTS survey administration, the wording of the item changed to the following: “In the past 12 months, have you used a computer, smartphone, or other electronic means to do any of the following… Used e-mail or the Internet to communicate with a doctor or a doctor’s office?” As with the first outcome of interest, these items were merged to

Table 2
Descriptive statistics of sociodemographic characteristics of respondents across the 6 survey administrations of HINTS between 2003 and 2017 used in these analyses; percentages are weighted to reflect national population estimates.

	HINTS 1 (2003) *n* (%)	HINTS 2 (2005) *n* (%)	HINTS 3 (2008) *n* (%)	HINTS 4 Cycle 1 (2011) *n* (%)	HINTS 4 Cycle 3 (2013) *n* (%)	HINTS 5 Cycle 1 (2017) *n* (%)	Adj F Value	p-value
Sex							22.74	<0.001
Female	3848 (48.1%)	3657 (51.9%)	4696 (51.4%)	2304 (51.5%)	1906 (51.6%)	1914 (51.1%)		
Male	2521 (51.9%)	1929 (48.1%)	2969 (48.6%)	1552 (48.5%)	1197 (48.4%)	1303 (48.9%)		
Age							82.52	<0.001
18–34	1656 (31.2%)	1037 (31.0%)	1113 (30.8%)	582 (30.3%)	426 (27.2%)	367 (21.9%)		
35–49	1961 (31.1%)	1494 (30.1%)	1831 (29.6%)	932 (27.3%)	712 (30.5%)	655 (28.7%)		
50–64	1492 (21.5%)	1522 (22.8%)	2451 (23.1%)	1339 (25.2%)	1070 (25.1%)	1063 (30.1%)		
65–74	694 (9.7%)	812 (9.3%)	1189 (8.4%)	583 (9.2%)	514 (9.4%)	676 (11.1%)		
≥75	548 (6.6%)	707 (6.7%)	1010 (8.1%)	455 (8.0%)	360 (7.9%)	385 (8.2%)		
Race/ethnicity							45.78	<0.001
NH White	4276 (71.8%)	4103 (69.9%)	5445 (69.3%)	2431 (66.8%)	1584 (66.9%)	1868 (65.7%)		
Hispanic	764 (11.7%)	496 (13.0%)	622 (12.8%)	461 (14.5%)	511 (15.4%)	427 (15.7%)		
NH Black	716 (10.5%)	438 (10.0%)	687 (11.5%)	576 (11.4%)	421 (10.5%)	409 (10.3%)		
NH Other	312 (6.0%)	299 (7.2%)	424 (6.4%)	208 (7.4%)	209 (7.2%)	249 (8.3%)		
Education							386.00	<0.001
Less than high school	747 (16.9%)	687 (14.5%)	683 (13.9%)	391 (12.8%)	297 (9.7%)	217 (8.7%)		
High school graduate	1828 (32.0%)	1447 (29.9%)	1804 (26.6%)	785 (23.1%)	699 (24.4%)	616 (22.9%)		
Some college	1637 (26.8%)	1545 (32.2%)	2192 (34.8%)	1167 (31.1%)	933 (33.7%)	942 (32.8%)		
College graduate	1927 (24.3%)	2637 (24.7%)	2637 (24.7%)	1531 (32.9%)	1167 (33.2%)	1406 (35.6%)		
Income							10.30	<0.001
<$20,000	1111 (19.2%)	899 (17.7%)	1142 (19.8%)	829 (24.3%)	680 (20.2%)	559 (17.4%)		
$20,000 to <$35,000	1295 (22.5%)	868 (17.7%)	1056 (16.7%)	584 (17.2%)	418 (14.5%)	423 (12.2%)		
$35,000 to <$50,000	958 (17.6%)	652 (14.2%)	873 (14.0%)	520 (12.6%)	394 (14.7%)	386 (14.9%)		
$50,000 to <$75,000	955 (17.7%)	924 (22.0%)	1203 (19.1%)	594 (16.9%)	446 (17.7%)	530 (19.1%)		
$75,000 +	1214 (23.1%)	1150 (28.4%)	2041 (30.4%)	1031 (29.0%)	801 (33.0%)	1064 (36.3%)		
Geography							4.11	0.004
Urban	5174 (80.9%)	4352 (80.0%)	6192 (82.2%)	3321 (84.2%)	2709 (82.1%)	2812 (84.4%)		
Rural	1195 (19.1%)	1234 (20.0%)	1482 (17.8%)	638 (15.8%)	476 (17.9%)	473 (15.6%)		

create one variable representing whether the respondent had or had not e-mailed or communicated with their health care provider in the past 12 months.

For this outcome, those asked this question again changed with the 2017 survey administration. Earlier surveys asked this question of anyone with internet access; in 2017, the item was asked of all survey participants.

Independent variables

Independent variables of interest included sociodemographic variables previously shown to be related to the digital divide; namely, age, sex, race/ethnicity, education, income, and geography [8,9,15]. All variables were examined categorically, per prior HINTS methodology recommendations and prior published work. [6,7] Age was divided into the following categories: 18–34, 35–49, 50–64, 65–74, and 75+. Sex was assessed as a binary variable (male or female). Race/ethnicity was collapsed into four categories: non-Hispanic white, Hispanic, non-Hispanic black, and non-Hispanic other. Non-Hispanic Other includes non-Hispanic respondents who self-reported being American Indian or Alaska Native, Asian Indian, Chinese, Filipino, Japanese, Korean, Vietnamese, Other Asian, Native Hawaiian, Guamanian or Chamorro, Samoan, or other Pacific Islander, or who selected multiple races. This was done in part due to low numbers of respondents in each of these categories. Education categories were collapsed to create the following categories: Less than High School, High School, Some College, and College Graduate or Higher. Income was self-reported by respondents referencing current US dollar values at the time of survey completion, and was analyzed categorically (<$20,000, $20,000 to <$35,000, $35,000 to <$50,000, $50,000 to <$75,000, and >$75,000). Geography was dichotomized into rural and urban based on the United States Department of Agriculture's 2003 Rural-Urban Continuum Codes (RUCC). Briefly, urban categorization included RUCCs 1–3 (metro area counties with greater than 20,000 residents) and rural categorization included RUCCs 4–9 (non-metro counties with populations ranging from 2500 to 20,000). [16]

Statistical analyses

Data were analyzed using SAS 9.4 survey procedures, which accounted for complex sampling procedures used in HINTS data collection. All analyses used jackknife weights to produce population-level point estimates and to compute accurate variance estimates. Descriptive statistics were tabulated for all items. The effects of the independent variables detailed above (age, sex, race/ethnicity, education, income, and geography) were computed using multivariable logistic regression; additionally, predicted marignals were calculated in an effort to detect significant differences in groups for each of the outcome variables over time.

Results

Across the six survey administrations of HINTS used in these analyses, respondents generally were female, aged 35–64, non-Hispanic white, have some college education, make $35,000 or more per year, and reside in urban areas (Table 2). Bivariate analyses indicated that there were statistically significant differences in respondent characteristics for each variable examined (sex, age, race/ethnicity, education, income, and geography); however, when examining the weighted percentages, the differences in percentage themselves have little variation across survey administrations. [6]

Modelling disparities in electronic personal health information usage

In the overall model of ePHI tool usage, the percentage of individuals who reported tracking ePHI online increased from 14.2% and 70.9% between 2008 and2017 (Fig. 1). Management of ePHI online increased with each HINTS survey administration ($p < 0.001$; Table 3). When compared to non-Hispanic white respondents, non-Hispanic other respondents had greater odds of tracking health information online (Odds Ratio [OR] = 1.41 Confidence Interval [CI] = 1.01, 1.96). Similarly, female respondents had increased odds of tracking ePHI online as compared to male counterparts (OR = 1.37, CI = 1.13, 1.67). Online management of health information was significantly associated with sex, race/ethnicity,

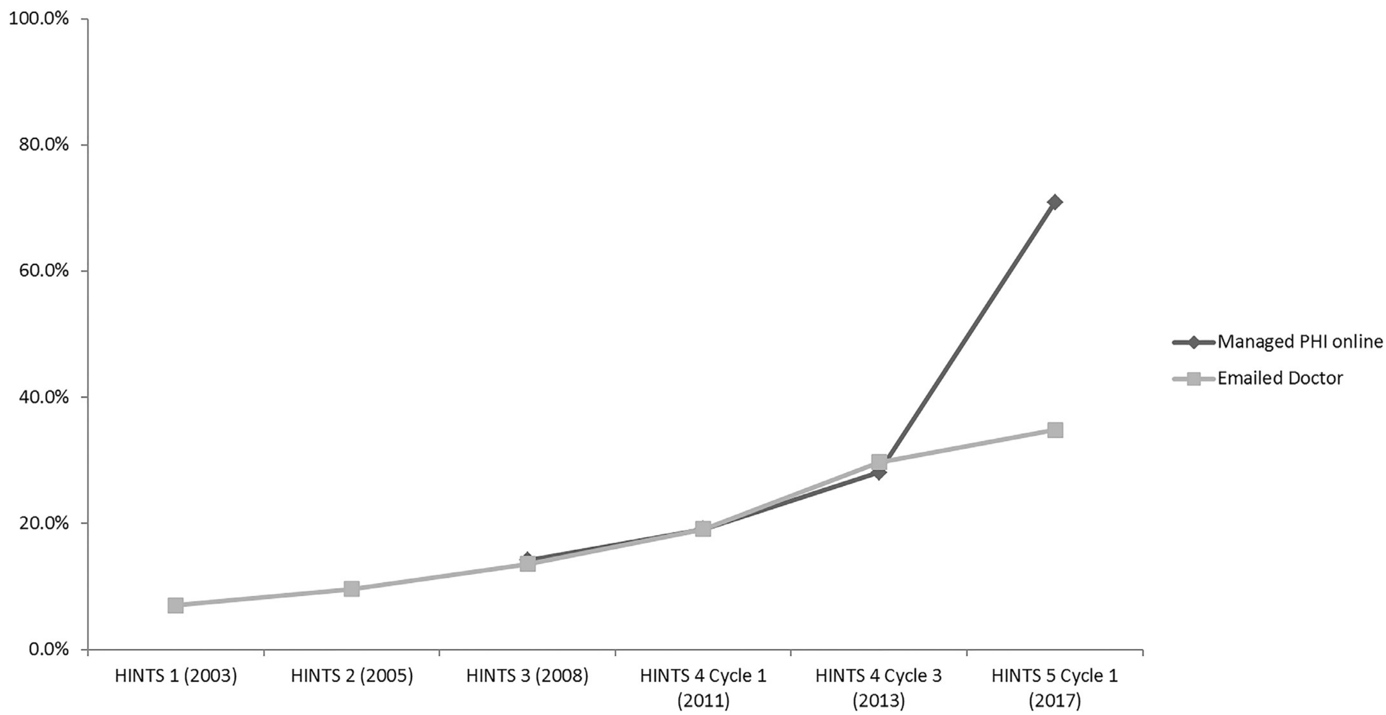

Fig. 1. Percentage of U.S. adult population with internet access who have managed their electronic personal health information (ePHI) online ($N = 18{,}103$) or emailed their doctor or other healthcare provider ($N = 20{,}252$), Health Information National Trends Survey (HINTS) 2003, 2005, 2008, 2011, 2013, and 2017. Survey question on managing ePHI online not included in HINTS 4 Cycle 2 (2012) or HINTS 4 Cycle 4 (2014) survey administrations.

Table 3
Predictors of managing electronic Personal Health Information (ePHI) online among respondents to the Health Information National Trends Survey (HINTS) in 2008, 2011, 2013, and 2017.

	Predictors of managing ePHI online				
	Odds ratio (95% CI)	Beta coefficient	SE beta	Adj wald *F*	*P-value*
Sex				11.43	0.0007
Female	Ref	Ref	Ref		
Male	0.73 (0.60, 0.88)	−0.16	0.05		
Age				7.44	0.1143
18–34	Ref	Ref	Ref		
35–49	0.79 (0.64, 0.99)	−0.12	0.07		
50–64	0.83 (0.70, 0.99)	−0.07	0.06		
65–74	0.81 (0.63, 1.04)	−0.10	0.09		
≥75	1.06 (0.78, 1.45)	0.17	0.12		
Race/ethnicity				8.39	0.0386
NH White	Ref	Ref	Ref		
Hispanic	1.22 (0.94, 1.58)	0.03	0.09		
NH Black	0.99 (0.76, 1.29)	−0.17	0.09		
NH Other	1.59 (1.11, 2.30)	0.30	0.13		
Education				28.07	<0.0001
Less than high school	Ref	Ref	Ref		
High school graduate	0.93 (0.54, 1.62)	−0.27	0.10		
Some college	1.38 (0.82, 2.33)	0.12	0.09		
College graduate	1.72 (1.07, 2.78)	0.34	0.08		
Income					
<$20,000	Ref	Ref	Ref	45.17	<0.0001
$20,000 to <$35,000	1.26 (0.91, 1.74)	−0.18	0.10		
$35,000 to <$50,000	1.55 (1.08, 2.23)	0.03	0.12		
$50,000 to <$75,000	1.76 (1.34, 2.31)	0.15	0.07		
$75,000 +	2.24 (1.73, 2.91)	0.40	0.08		
Geography				11.13	0.0008
Urban	Ref	Ref	Ref		
Rural	0.68 (0.54, 0.86)	−0.19	0.06		
HINTS Survey Year				876.92	<0.0001
HINTS 3 (2008)	Ref	Ref	Ref		
HINTS 4 Cycle 1(2011)	1.53 (1.24, 1.90)	−0.62	0.07		
HINTS 4 Cycle 3 (2013)	2.60 (2.07, 3.26)	−0.09	0.07		
HINTS5 Cycle 1 (2017)	16.47 (13.31, 20.38)	1.76	0.06		

education, income, geography, and survey year (Table 3; Fig. 2a, c–f). Age was the only variable that did not have a significant association with ePHI (Table 3, Fig. 2b).

Analysis of the predicted marginals between each sociodemographic characteristic and survey year was assessed to identify specific disparities. For all variables, predicted marginal were statistically significant for all subgroups ($p < 0.05$), indicating significant increases over time (Fig. 2). However, not all of these statistically significant differences were large enough in magnitude to be considered impactful.

When examining the association between age and ePHI over time, the difference in usage became statistically significant ($p < 0.05$). The largest disparities were seen in 2008, when 24% of those over the age of 75 reported using ePHI to manage their healthcare, as compared to 12% of those aged 18–34 and 35–49 (Fig. 2b). Differences between age groups decreased during the 2011 and 2013 HINTS cycles; however, there was a notable change in age groups using ePHI to manage healthcare in 2017, when 78% of those aged 18–34 reported doing so versus 70% of those aged 65 and older.

ePHI use increased in a statistically significant ($p < 0.05$) manner across all race/ethnicity groups between 2008 and 2017 (Fig. 2c). The greatest difference in 2008 was between Hispanic respondents (19%) and non-Hispanic white respondents (12%). In 2011 and 2013, there was a large disparity between non-Hispanic Other respondents and all other respondents in terms of ePHI usage (27% and 49% in 2011 and 2013, respectively, compared to 18% and 26% in non-Hispanic whites; Fig. 2b). In 2017, non-Hispanic other respondents continued to report the highest usage of ePHI (78%), compared to Hispanic respondents (75%), non-Hispanic white respondents (72%), and non-Hispanic black respondents (63%).

Those with some college education or a college degree consistently reported a significantly higher usage of ePHI to manage healthcare as compared to those with a less than a high school diploma (Fig. 2d). The disparity between those with a college degree and those with a less than college degree was not significant in 2008 (16% and 17%, respectively), but grew dramatically in 2011 (24% and 14%). The gap between these two groups continued to widen in 2017 such that 80% of college graduates reporting ePHI use compared to 51% of those with less than a high school diploma ($p < 0.05$).

A statistically significant increase over time was observed in usage of ePHI over time across income groups ($p < 0.05$; Fig. 2e). The largest gap in usage in 2008 was between those making \$30,000 to <\$50,000 per year (18%) and those with an annual income of less than \$20,000 (11%). The gap disparity between the highest income group and the lowest widened over time, beginning in 2013, when 37% of those with an income greater than \$75,000 reported using ePHI, as compared to those in the lowest income bracket who reported 19% usage. This divide grew rapidly between 2013 and 2017, when 82% of those with an income greater than \$75,000 reported using ePHI tools, as compared to those in the lowest income bracket who reported 50% usage.

The disparity in use of ePHI between those respondents living in rural and urban areas remained statistically significant for each survey administration, though usage increased for both groups across the study period (Fig. 2f). In 2008, 8% of rural residents reported using ePHI tools to manage their healthcare, compared to 14% of their urban counterparts. This disparity grew to its largest in 2013, when only 16% of rural residents reported ePHI usage, versus 31% of urban respondents. The gap has persisted, with 74% of urban residents using ePHI tools and 62% of rural residents doing so.

Across all sociodemographic variables, a statistically significant increase was observed between 2008 and 2017 data. Therefore, we examined the distribution of the tasks used to create the 2017 ePHI variable to help determine whether an individual item was responsible for the dramatic increase in ePHI between 2013 and 2017. Of those who responded to the item regarding making appointments online with a health care provider, 1096 of 2521 respondents said that they had done so (weighted percentage = 42.3%). To the item addressing whether they had "… Track health care charges and costs," 917 of 2508 respondents said "yes" (38.4%). Of those who responded to the item regarding whether they had "… Filled out forms or paperwork related to your health care," 1119 of 2522 respondents said "yes" (45.7%). Finally, to the item addressing whether respondents had used their ePHI tools to "… Look up test results," 1030 of 2521 respondents said "yes" (37.4%). Further sensitivity analyses revealed that no single task seems to be driving the dramatic increase in ePHI usage. However, as this question was asked only of those who responded that they had accessed their medical records in the past year, whereas the original question was asked of anyone reporting having internet access. This could potentially account for some of the dramatic increase seen in these analyses.

Modeling disparities in emailing providers

The percentage of respondents communicating electronically with their health care providersincreased from 7.0% to 41.1% between 2003 and 2017 (Fig. 1). Similar to management of ePHI online, the odds of e-mailing doctors increased over time ($p < 0.001$; Table 4). Females had higher odds of emailing providers than males (OR = 1.32, 95% CI = 1.15–1.54). College graduates had a 2.64-fold increased odds of contacting a provider electronically compared to those who had less than a high school education (95% CI = 1.47–4.76). Those who reported an annual income of \$75,000 or greater had a 2.14-fold increased odds of emailing a provider compared to those with less than \$20,000 (95% CI = 1.57–2.91; Table 4). Also of note was the significantly lower odds of emailing doctors for rural residents as compared to urban residents (OR = 0.65, 95% CI = 0.54–0.78). Emailing doctors was not associated with age or race/ethnicity ($p > 0.05$; Table 4; Fig. 3b and c).

Unlike ePHI usage, when examining the interaction between age group and survey year over time for emailing healthcare providers, a statistically significant difference did not arise (Fig. 3b). No clear trend arose from the results, as no one age group consistently reported higher usage than any other.

When looking at the predicted marginals for race/ethnicity over time, non-Hispanic others had a dramatically increased usage of contacting their provider electronically in 2011 and 2013 (26% and 40%, respectively, compared with 18% and 29% of non-Hispanic whites; Fig. 3c). This disparity shrunk in 2017; however, a new, larger gap between Hispanics and the other three groups appears, with 33% of Hispanics reporting that they emailed their provider (versus 41% of non-Hispanic whites).

Differences in emailing doctors across levels of education again followed a pattern similar to that of ePHI tool usage (Fig. 3d). Differences were smaller in 2003, when 10% of college graduates reported emailing their healthcare provider as compared with 4% of those who had less than a high school education. The disparity between college graduates and those with less than a high school diploma began to grow in 2008, and continued to grow quickly; in 2017, 52% of college graduates reported that they emailed their providers, compared to 10% of those with less than a high school education.

Over time, all income groups reported increasingly emailing their doctors and healthcare providers (Fig. 3e). Again, much like ePHI usage, there were few differences in 2003 and 2005; however, a growing disparity emerged in 2008, when 19% of those who reported annual incomes of \$75,000 or greater stated that they had emailed their doctor, compared to 11% of those with an

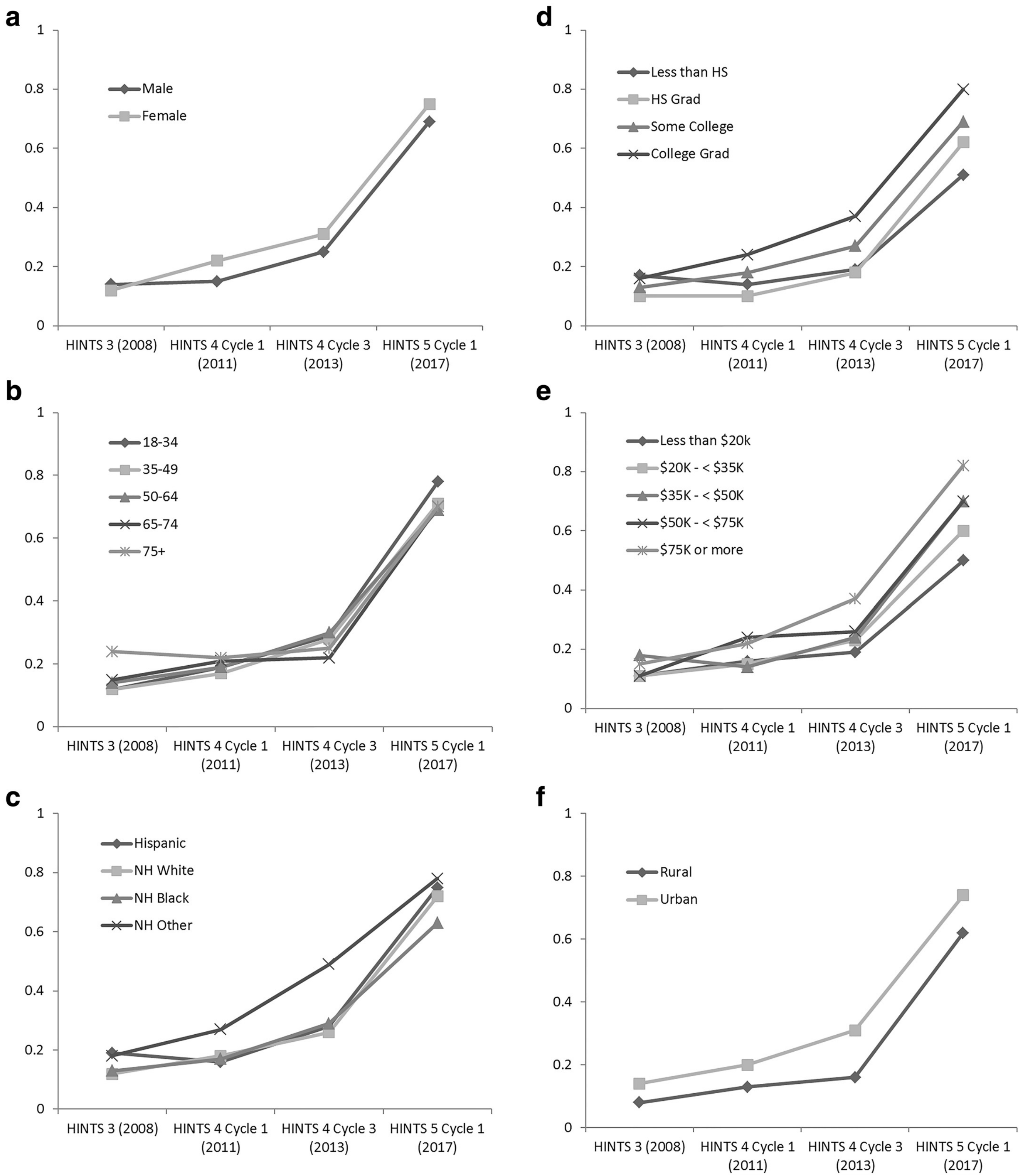

Fig. 2. Trends of using the internet to manage personal health information online in the past 12 months by HINTS survey cycle. a) predicted marginals by sex b) predicted marginals by age, c) predicted marginals by race/ethnicity, d) predicted marginals by education, e) predicted marginals by income, f) predicted marginal by geography. All results show are from multivariable models adjusted for sex, age category, race/ethnicity, education, income, and geography.

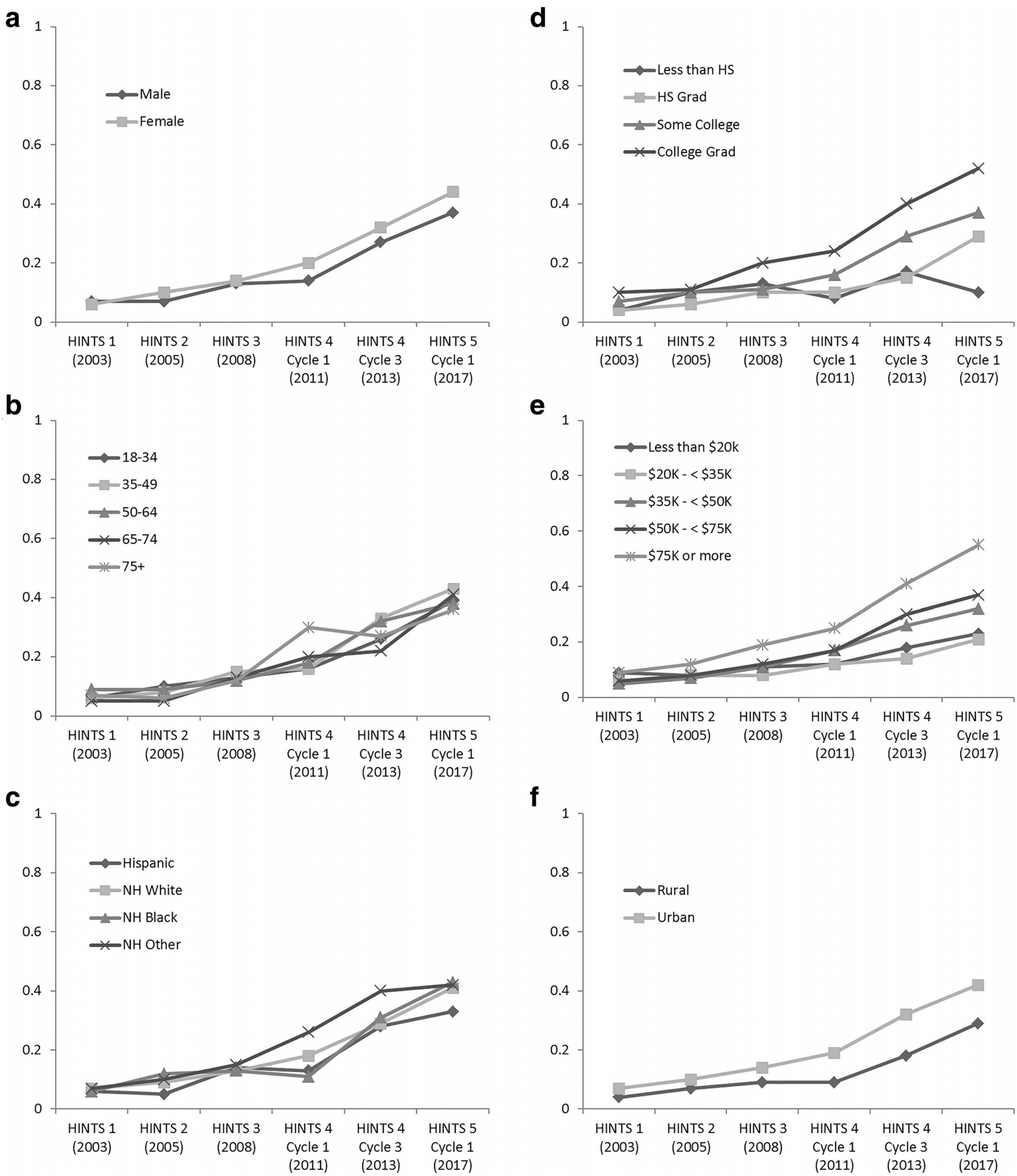

Fig. 3. Trends of using the internet to email doctor or other provider in the past 12 months by HINTS survey cycle. a) predicted marginals by sex b) predicted marginals by age, c) predicted marginals by race/ethnicity, d) predicted marginals by education, e) predicted marginals by income, f) predicted marginal by geography. All results show are from multivariable models adjusted for sex, age category, race/ethnicity, education, income, and geography.

Table 4
Predictors of emailing a healthcare provider among respondents to the Health information National Trends Survey (HINTS) in 2003, 2005, 2008, 2011, 2013, and 2017.

	Predictors of emailing a healthcare provider				
	Odds ratio (95% CI)	Beta coefficient	SE beta	Adj wald *F*	*P-value*
Sex				15.17	<0.0001
Female	Ref	Ref	Ref		
Male	0.76 (0.65, 0.87)	−0.14	0.04		
Age				3.48	0.4817
18–34	Ref	Ref	Ref		
35–49	1.04 (0.82, 1.31)	0.89	0.06		
50–64	0.95 (0.76, 1.19)	−0.001	0.06		
65–74	0.93 (0.73, 1.18)	−0.09	0.08		
≥75	1.23 (0.86, 1.75)	−0.08	0.11		
Race/ethnicity				1.52	0.6781
NH White	Ref	Ref	Ref		
Hispanic	0.93 (0.69, 1.25)	−0.11	0.12		
NH Black	1.10 (0.85, 1.43)	0.06	0.11		
NH Other	1.12 (0.87, 1.44)	0.08	0.10		
Education				37.33	<0.0001
Less than high school	Ref	Ref	Ref		
High school graduate	1.31 (0.71, 2.43)	−0.21	0.12		
Some college	2.00 (1.15, 3.45)	0.20	0.08		
College graduate	2.64 (1.47, 4.76)	0.48	0.09		
Income					
<$20,000	Ref	Ref	Ref	139.50	<0.0001
$20,000 to <$35,000	0.86 (0.62, 1.19)	−0.38	0.08		
$35,000 to <$50,000	1.20 (0.79, 1,83)	−0.05	0.11		
$50,000 to <$75,000	1.42 (1.05, 1.93)	0.13	0.07		
$75,000 +	2.14 (1.57, 2.91)	0.53	0.06		
Geography				21.33	<0.0001
Urban	Ref	Ref	Ref		
Rural	0.65 (0.54, 0.78)	−0.22	0.05		
HINTS Survey Year				754.03	<0.0001
HINTS 1 (2003)	Ref	Ref	Ref		
HINTS 2 (2005)	1.31 (1.01, 1.70)	−0.71	0.08		
HINTS 3 (2008)	2.04 (1.72, 2.41)	−0.26	0.06		
HINTS 4 Cycle 1(2011)	2.79 (2.19, 3.57)	0.05	0.08		
HINTS 4 Cycle 3 (2013)	5.50 (4.48, 6.75)	0.73	0.07		
HINTS 5 Cycle 1 (2017)	8.40 (6.83, 10.32)	1.15	0.06		

income of less than $20,000. This gap was widened since 2008; nearly ten years later, in 2017, 55% of those in the highest income group reported contacting their provider via email, while only 23% of those in the lowest income group had done so.

The disparities between rural and urban residents in emailing their healthcare providers again mirrored the disparities seen in the use of ePHI between these two groups (Fig. 3f). In 2003, 7% of those in urban areas reported emailing their healthcare provider, compared to 4% of those in rural areas. In 2011, this gap widened to a 10% difference (19% of urban residents versus 9% of rural residents), and continued to grow through 2017 to a 13% difference (42% of urban residents versus 29% of rural residents).

Discussion

The primary objective of this study was to assess progress toward the HP2020 objectives regarding use of the internet to manage ePHI and emailing healthcare providers. The HP2020 targets have been met and adoption of these HC/HIT tools of interest continues to grow overall [2,6]. While dramatic increases were seen between 2013 and 2017 for all sociodemographic groups, the digital divide persists for sex, age, education, income, race/ethnicity, and geography [2,6]. Women had significantly higher odds of managing their ePHI online and of emailing their healthcare providers as compared to their male counterparts. These findings are consistent with what has been previously reported in the literature in that being female is a significant predictor of accessing health information online and communicating with providers electronically [17]. Interestingly, it has also been shown that women are more likely to turn to their provider, relatives, or friends when seeking health information than men, who would look to the internet for information. [18] Therefore, the sex disparity seems to depend on the type of HIT tool and the task at hand.

While age was not statistically significantly associated with either ePHI use or e-mailing healthcare providers in the overall model, the predicted marginal analysis revealed that the age disparities previously reported on in the literature persist. The greatest gap found in this study is between those aged 65 and older and those aged 18–34; that is, a generational difference between baby boomers and millennials or “digital natives.” This has been shown to be a disparity in the literature for many years, and remains a challenge to this day [17–20]. Part of the challenge may be due to the fact that fewer older adults are offered access to their online records and ePHI as compared to younger individuals [17]. An additional challenge, however, may be in ensuring that the design of HIT tools meet the technologic literacy level of older adults [21–23,31–34].

Individuals reporting a higher level of education and/or income were significantly more likely to manage their ePHI online and to contact their healthcare providers electronically than those with lower levels of education and income, respectively. While smartphones and other mobile devices have become ubiquitous in our culture, purchasing one is still a significant investment, which has slowed the adoption of this technology among some populations; this, coupled with lower rates of having regular access to the internet, has been identified as a barrier to accessing ePHI tools online and to communicating electronically with providers [17]. Additionally, those with lower levels of education and lower health and technologic literacy are less likely to access their ePHI or to engage with HIT [17].

Non-Hispanic other respondents were significantly more likely to use the internet to manage their ePHI as compared with non-Hispanic whites; however, no difference was seen between non-Hispanic blacks and Hispanics compared with non-Hispanic whites. While this trend was significant, it is difficult to interpret due to the heterogeneous nature of those respondents included in the Non-Hispanic Other group. No differences were seen regarding odds of communicating electronically with healthcare providers by race/ethnic group. This is generally in line with what has been previously reported in the literature, including the reduced use of ePHI among Hispanic individuals. While the disparity between some of the other race/ethnic groups has largely disappeared, recent studies have shown that the disparity re-emerges when looking at the interaction between race/ethnicity and socioeconomic group. For example, a study in New York showed that, while racial disparities had shrunk overall for EHR use, the introduction of socioeconomic status into the equation revealed that lower-income minorities were less likely to adopt and use EHRs [24]. Part of this disparity may fueled by whether these individuals are actually offered access proactively by their provider or provider's office; therefore, it is critical that healthcare providers actively offer access to all patients, regardless of race or ethnicity [25].

Compared to their counterparts living in rural areas, those living in urban areas were significantly more likely to both manage their ePHI using the internet and email their healthcare provider. This is disparity has been reported on previously by our group, and geographic barriers have been highlighted as a key challenge to diffusion of this technology [10]. As with race and ethnicity, part of this gap in usage may be due to lower rates of being offered access for those in rural areas [25].

Some of these disparities in HC and HIT adoption may be explained by underlying disparities in access to the internet amongst these sociodemographic groups in the United States; these were not included in the HP2020 metric as the objectives apply to the total population, not just those with internet access [8,9]. Furthermore, how one accesses the internet (computer, mobile device, etc.) may play a role in use of these HC/HIT tools by the general public. A recent study using data from the Pew Internet and American Life Project found a dramatic increase across all sociodemographic groups in the percentage of individuals who access the internet via a smartphone or mobile device; these differences in use of and dependence upon smartphones to access the internet vary by sociodemographic groups, including age, race, income and education [26]. Disparities in internet access and means of internet access are seen internationally as well, and vary by many of the same sociodemographic characteristics as in the United States [27–29]. As mobile internet access increases and as cost of mobile devices decreases nationally and internationally, and as reliance on broadband infrastructure decreases in parallel, we hypothesize that these gaps will continue to narrow [7,26–29]. Additionally, policy initiatives targeted toward narrowing the gap in internet access between groups such as rural and urban residents may help to decrease the disparities seen here in use of HC and HIT tools [11]. However, as stated earlier, this must be done in concert with a stronger effort to actively offer access to these tools to all groups.

While there are studies showing that health outcomes may improve with internet access and, in turn, access to tools like ePHI and electronic communication with healthcare providers, informatics interventions are not a blanket solution for all healthcare delivery and patient care challenges [35,36]. In national goal-setting such as that done through the upcoming HP2030, it is important to understand that health and HIT-based interventions can exacerbate existing inequalities [36]. As stated earlier, there is a disconnect between perception of access by healthcare providers (i.e., "all patients are able to access their EHRs"), patient awareness of this access, and whether patients are actively offered access. Furthermore, increased availability of HC and HIT tools may not translate directly to increased use of such resources in some populations due to lower levels of health, technologic, and internet literacy or lower feelings of self-efficacy with regard to taking care of one's own health [30,36]. Such factors should be considered when setting objectives for broad populations like HP2030, and may need to be incorporated into the objectives themselves.

Strengths of the present study include the use of a nationally-representative, repeated cross-sectional survey with common items, which includes sampling weights, calculated post-stratification to enable the calculation of accurate population-level estimates. Additionally, the sampling paradigm includes over-sampling for underrepresented minorities. For these reasons, the HINTS items used here serve as the official items for benchmarking these HP2020 objectives.

Limitations to this study are largely those typical of cross-sectional study design, including response rates, and the ability to estimate association but not causation. An additional limitation is that these items have changed over time (namely, become more specific), which may have influenced some of the results; additionally, these changes included the subgroup of respondents whose prior question responses branched them to these items. Finally, a recent study conducting a nonresponse bias analysis of HINTS cycles 1 and 3 compared response rates for subgroups with respondents from the Medical Expenditure Panel Survey (MEPS) and the National Health Interview Survey (NHIS) [14]. This team's analysis found that areas in which there were more young households, minority populations, and lower socioeconomic status had lower response rates. Furthermore, those who responded to the HINTS mailings were biased towards those with higher levels of information seeking. We attempt to address some of these biases using the jackknife weighting paradigm detailed above; however, we acknowledge that this may not completely address some of these challenges.

In conclusion, adoption by the general public of tools to increase management of ePHI online and communicate with healthcare providers has significantly exceeded the target percentages set forth in the HP2020 objectives regarding these aspects of HC/HIT. We hypothesize that this relatively rapid adoption of such tools is due in part to a combination of healthcare telecommunications policies, such as those put forth in the HITECH and subsequent health technology acts, funding, and increasing availability of internet access nationwide. That said, disparities continue to exist among certain sociodemographic groups; these groups should be given special consideration when creating HC- and HIT-based policies and interventions nationally and internationally to avoid exacerbating existing digital divides. Interventions should address the health, technologic, and internet literacy of the target populations, the awareness of HIT among these individuals, and self-rated ability to manage their own health and healthcare.

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Competing interests

None declared.

Ethical approval

HINTS was approved by the Westat IRB in an expedited review and was deemed exempt from IRB review by the NIH Office of Human Subjects Research. The public-use datasets used in this analysis are de-identified.

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