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Health Information Technology Use among Chronic Disease Patients: An Analysis of the United States Health Information National Trends Survey

Geetanjali Rajamani[1,2] Elizabeth Lindemann[2,3] Michael D. Evans[4] Raghu Pillai[3] Sameer Badlani[3] Genevieve B. Melton[2,3,5,6]

[1] Medical School, University of Minnesota, Minneapolis, Minnesota, United States
[2] Center for Learning Health System Sciences, University of Minnesota, Medical School, Minneapolis, Minnesota, United States
[3] Information Technology, Fairview Health Services, Minneapolis, Minnesota, United States
[4] Biostatistical Design and Analysis Center, Clinical and Translational Science Institute, University of Minnesota, Minneapolis, Minnesota, United States
[5] Department of Surgery, University of Minnesota, Medical School, Minneapolis, Minnesota, United States
[6] Institute for Health Informatics, University of Minnesota, Minneapolis, Minnesota, United States

Address for correspondence Geetanjali Rajamani, BS, Medical School, University of Minnesota, Minneapolis, MN 55455, United States (e-mail: rajam017@umn.edu).

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Abstract

Background Chronic disease is the leading cause of mortality in the United States. Health information technology (HIT) tools show promise for improving disease management.

Objectives This study aims to understand the following: (1) how self-perceptions of health compare between those with and without disease; (2) how HIT usage varies between chronic disease profiles (diabetes, hypertension, cardiovascular disease, pulmonary disease, depression, cancer, and comorbidities); (3) how HIT trends have changed in the past 6 years; and (4) the likelihood that a given chronic disease patient uses specific HIT tools.

Methods The Health Information National Trends Survey (HINTS) inclusive of 2014 to 2020 served as the primary data source with statistical analysis completed using Stata. Bivariate analyses and two-tailed *t*-tests were conducted to compare self-perceived health and HIT usage to chronic disease. Logistic regression models were created to examine the odds of a specific patient using various forms of HIT, controlling for demographics and comorbidities.

Results Logistic regression models controlling for sociodemographic factors and comorbidities showed that pulmonary disease, depression, and cancer patients had an increased likelihood of using HIT tools, for example, depression patients had an 81.1% increased likelihood of looking up health information ($p < 0.0001$). In contrast, diabetic, high blood pressure, and cardiovascular disease patients appeared to use

Keywords
- mobile platforms
- consumer health informatics
- patients with chronic illness or special needs
- other clinical informatics applications
- internet and the web technology
- information seeking

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HIT tools at similar rates to patients without chronic disease. Overall HIT usage has increased during the timeframe examined.

Conclusion This study demonstrates that certain chronic disease cohorts appear to have greater HIT usage than others. Further analysis should be done to understand what factors influence patients to utilize HIT which may provide additional insights into improving design and user experience for other populations with the goal of improving management of disease. Such analyses could also establish a new baseline to account for differences in HIT usage as a direct consequence of the novel coronavirus disease 2019 (COVID-19) pandemic.

Background and Significance

Chronic disease, defined generally as a disease lasting more than a year and requiring ongoing medical attention and lifestyle changes, is the leading cause of mortality and morbidity in the United States.[1] Common examples of chronic disease include cardiovascular disease, diabetes, and cancer.[1] About 6 in 10 Americans have a chronic disease, with 4 in 10 reporting two or more such diseases.[2] In addition to their significant prevalence, chronic disease is the leading driver of the nation's $3.8 trillion health care costs.[2] Thus, methods to manage treatment and lifestyle changes for patients to combat chronic diseases are of the utmost importance for improving clinical outcomes.

Health information technology (HIT) solutions are a promising method for management of chronic diseases and improving the patient's consumer experience. HIT is defined as "the electronic systems health care professionals and patients use to store, share, and analyze health information."[3] While some HIT solutions, such as electronic health records (EHRs), are widely integrated in health care, HIT solutions for many other applications have been reported but are less widely used, ranging from technology for medication tracking to solutions using virtual reality to treat mental health disorders.[4] Utilizing applications and other HIT tools that are tailored toward specific patient populations, for example, chronic pulmonary disease patients, appears to be a promising approach to increase the involvement of patients in their own health care, hence potentially reducing the overall burden of chronic disease.

Previous research has shown positive effects resulting from HIT solutions used to aid in chronic disease management.[5] In a meta-analysis by Thakkar et al,[6] text messages with providers significantly improved medication adherence in a pool of 2,742 chronic disease patients. Similarly, a review by Triantafyllidis et al[7] demonstrated improved health outcomes associated with the use of HIT solutions in a study examining blood glucose levels, physical activity, and lung function parameters. Studies have also shown how HIT utilization varies greatly by demographic factors, such as race/ethnicity, educational attainment, and socioeconomic status.[8] There is often significant overlap between demographic factors and people who have chronic diseases, and disparities in HIT use among minorities with chronic disease has been well documented.[9]

Although it is well known that HIT can be a powerful tool in management of disease (among those who have access), there exists a gap in the literature regarding overall trends of HIT usage among chronic disease patients. It remains unclear how usage varies between chronic disease cohorts and what can be learned from the most successful HIT tools. This is important because understanding which tools are successful at engaging certain populations, and understanding characteristics of the populations with most engagement can help researchers design future tools to optimize engagement in health care and ultimately improve disease management.

To address this, we analyzed a consumer-facing survey and information about HIT usage among chronic disease patients and provide recommendations and observations for improved chronic disease management using HIT solutions.

Objectives

The objective of this study is to examine how HIT usage varies between different chronic disease categories (patients with diabetes, hypertension, cardiovascular disease, pulmonary disease, depression/anxiety, cancer, comorbidities, and no disease) using a national survey of American adults in an effort to understand which tools and populations are most successful in engaging with HIT.

The specific research questions investigated are mentioned below:

- What are the self-perceptions of chronic disease patients in their health and confidence in taking care of their health?
- How does the usage of various HIT tools compare in patients with chronic diseases versus those without?
- How have HIT usage trends changed over time (from 2014 to 2020) in chronic disease patients?
- Can we predict which chronic disease patients are most likely to use specific HIT tools, controlling for sociodemographic factors and comorbidities?

Methods

The Health Information National Trends Survey (HINTS),[10] sponsored by the U.S. National Cancer Institute (NCI), was analyzed to understand trends in HIT usage for chronic disease management.

Sample

HINTS is a publicly available cross-sectional survey of a nationally representative sample of American adults (age 18+ years), administered regularly since 2003. Participants are selected at random from an address databank, and surveys are administered via mail. This survey instrument consists of a total of 122 close-ended questions organized into 15 sections. All data are quantitative and deidentified. For this study, the latest available data were primarily utilized: HINTS 5 (Cycle 4), collected from February to June 2020 ($n = 3865$),[11] with a response rate of 37%.

Exclusion criteria included the following: (1) addresses that were selected but included certain types of PO boxes were excluded due to high undeliverable rates and (2) surveys that were returned incomplete or incorrectly filled out were excluded ("complete" entails 80% or more of the survey filled out).[12] Detailed sampling strategies are available in the HINTS 5, Cycle 4 methodology report.[12] For analyzing trends over time, additional data from HINTS 4 Cycle 4 (2014), HINTS 5 Cycle 1 (2017), HINTS 5 Cycle 2 (2018), and HINTS 5 Cycle 3 (2019) were utilized.

Measures: Chronic Disease and Demographics

To identify questions relevant to chronic disease within the HINTS questionnaire, a review of chronic disease definitions put forth by various organizations, conducted by Bernell ad Howard,[13] was utilized. Based on this review, we define chronic disease as "a long-lasting health condition of complex causality that may be managed but is generally incurable, including (but not limited to) cardiovascular disease, respiratory disease, cancer, and diabetes." As per this definition, we used the following question (taken from section H[14] of HINTS) to identify a participant's chronic disease status: "Has a doctor or other health professional ever told you that you had any of the following medical conditions: diabetes or high blood sugar? High blood pressure or hypertension? A heart condition such as heart attack, angina, or congestive heart failure? Chronic lung disease, asthma, emphysema, or bronchitis? Depression or anxiety disorder?" Additionally, this question (Section O) was included: "Have you ever been diagnosed as having cancer?" Note that these were the only questions in the survey pertaining to chronic disease, and other conditions that may be considered chronic in nature, such as stroke deficits, could not be analyzed due to lack of inclusion in HINTS.

To determine a participant's self-perception of health, we utilized the following questions from Section H: "In general, would you say your health is: excellent, very good, good, fair, or poor?" and "Overall, how confident are you about your ability to take good care of your health: completely confident, very confident, somewhat confident, a little confident, or not confident at all?"

In addition, demographic variables were utilized. These demographic variables helped characterize the general populations of people with chronic diseases versus those without. Additionally, they served as controls in the logistic regression models to best predict how chronic disease patients utilize HIT tools without confounders. The following demographic variables were taken from Section P of HINTS: age, highest grade or level of schooling, Hispanic/Latino/Spanish origin, and race. Smoking status was obtained from Section L. Note that these factors were included as all are likely confounders, given that disease status can vary drastically with demographics, socioeconomics, and smoking.

Measures: Health Information Technology Usage

To identify questions relevant to HIT use, the following definition of HIT was utilized: "HIT refers to the electronic systems health care professionals and patients use to store, share, and analyze health information."[3] Per this definition, we included any questions from HINTS relating to participants' use of electronic systems for health information purposes. ►Table 1 lists the HIT usage variables (section B and section D) included in analyses, along with their response options. Many "classic" forms of HIT are included in HINTS, such as applications for disease management and electronic wearable devices. Additionally, some newer forms of HIT, such as social media and YouTube videos, were also asked in the survey. These forms were included in analyses to understand how both traditional and new forms of HIT are utilized and if there is any difference in usage patterns between the two. Note that the survey did not contain questions regarding any other forms of HIT, for example, virtual reality and questions tangential to HIT use, but not directly related to health applications, were excluded from analyses (e.g., internet speed).

Data Analysis

Data analysis was conducted using Stata/IC 16.1 (StataCorp LLC, Texas, United States) software. First, univariate analyses were conducted to describe the general populations of patients with chronic disease versus patients without disease. Each chronic disease category, as well as an additional "comorbidities" and "no chronic disease" category, was analyzed using the aforementioned demographic variables, as seen in ►Table 2.

Next, bivariate analyses were conducted to understand how patients' self-perceived health and confidence varies by chronic disease status. Using each chronic disease as the independent variable, patients' self-perceived health, and confidence were compared against the "no chronic disease" category. For example, diabetic patients' self-perceived health and confidence were compared with patients without any disease.

Additionally, bivariate analyses were conducted to examine the relationship between HIT usage and chronic disease. Using each chronic disease as the independent variable, patients' usage of a variety of HIT tools were compared against the "no chronic disease" category, as seen in ►Table 3. A list of HIT variables examined is provided in ►Table 1. Chi-squared tests and two-tailed *t*-tests (or Fisher's exact test for cells with sample size less than 10) were conducted to determine the significance of these various relationships.

Additionally, using data from HINTS 4 Cycle 4 until HINTS 5 Cycle 4 (2014–2020), variations in HIT usage for patients across all chronic disease categories were examined. Specific HIT variables analyzed include use of health applications, looking up health information, watching YouTube health

Table 1 Selected HIT usage variables, HINTS 5 (Cycle 4)

HIT usage variables	Response options
Internet use	
B14: Sometimes people use the Internet to connect with other people online through social networks like Facebook or Twitter. This is often called "social media." In the past 12 months, have you used the Internet to: share health information on social networking sites, such as Facebook or Twitter?; participate in an online forum or support group for people with a similar health or medical issues?; watch health-related videos on YouTube?	Yes; no for each question
Smartphone use	
B5: In the past 12 months, have you used a computer, smartphone, or other electronic means to: look for health or medical information for yourself; use e-mail or the Internet to communicate with a doctor or a doctor's office?	Yes; no for each question
B7: On your smartphone, do you have any "apps" related to health and wellness?	Yes; no; don't know
B8: Has your smartphone helped you: track progress on a health-related goal such as quitting smoking, losing weight, or increasing physical activity?; make a decision about how to treat an illness or condition?	Yes; no for each question
Electronic wearable device usage	
B9: In the past 12 months, have you used an electronic wearable device to monitor or track your health or activity? For example, a Fitbit, Apple Watch, or Garmin Vivofit.	Yes; no
B10: In the past month, how often did you use a wearable device to track your health?	Every day; almost every day; 1–2 times per week; Less than once per week; I did not use a wearable device in the past month
Medical records	
D4: How many times did you access your online medical record in the last 12 months?	0; 1 to 2 times; 3 to 5 times; 6 to 9 times; 10 or more times

Abbreviations: HINTS, Health Information National Trends Survey; HIT, health information technology.

videos, communicating with providers, and accessing online medical records. These variables were chosen as they were commonly reported forms of HIT usage. The year 2014 was the earliest available survey released with all relevant questions included. Note that the 2014 HINTS survey did not ask about YouTube videos, looking up health information, and communicating with providers, and hence these variables are excluded in 2014 analyses. Additionally, due to large quantities of missing data in the "online medical record" category for 2018, this variable was excluded in 2018.

Finally, five separate multivariate logistic regression models were conducted to understand how HIT tools vary by chronic disease and demographic predictors. Specifically, use of health applications, looking up health information, watching YouTube health videos, communicating with providers, and accessing online medical records were each examined separately, with age, ethnicity/race, educational attainment, self-perceived health status, self-perceived confidence, smoking status, and chronic disease status as predictors (►Table 4). This ensured that predictions were not confounded by demographic factors or comorbidities.

Results

General Characteristics of Patients with Chronic Disease versus Patients Without

►Table 2 highlights some general characteristics of patients within each chronic disease category (diabetes, hypertension, cardiovascular disease, pulmonary disease, depression, and cancer), as well as patients with comorbidities and no reported chronic diseases. The average age for patients with chronic disease ranged from 43 (depression patients) to 66 years (cardiovascular disease patients). Of significance, patients with hypertension and pulmonary disease had a higher proportion of respondents identifying as non-White as compared with those without disease. Patients with diabetes, hypertension, and comorbidities reported significantly lower levels of educational attainment than those without any disease.

Self-Perceptions of Health and Confidence among Chronic Disease Patients

►Fig. 1A depicts participants' confidence in taking care of their own health by chronic disease status. A lower percentage of patients with chronic disease included in this study report their confidence as "completely confident" as compared with those without disease ($p < 0.0001$ for diabetes, hypertension, depression/anxiety, and comorbidities). For example, approximately 15.5% of patients with comorbidities report their confidence as "completely confident" as compared with 29.8% of participants without any disease.

►Fig. 1B depicts participants' self-reported health status by chronic disease. A lower percentage of patients with any chronic disease included in this study report their health status as "excellent" or "very good" as compared with those without disease ($p < 0.0001$ for all categories). For example,

Table 2 Descriptive overview of chronic disease and nonchronic disease populations, HINTS 5 (Cycle 4)

	Diabetes ($n=102$)	Hypertension ($n=478$)	Cardiovascular disease ($n=45$)	Pulmonary disease ($n=108$)	Depression/ anxiety ($n=292$)	Cancer ($n=133$)	Comorbidities ($n=1,455$)	No chronic disease ($n=1,130$)
Average age	61.22 (14.16)[a]	61.59 (13.83)	66.36 (16.42)	49.30 (16.66)	42.92 (14.79)	62.67 (14.04)	64.01 (14.31)	48.49 (16.31)
Race/ethnicity								
Non-Hispanic White	45 (50.56)[b]	253 (53.76)[c]	37 (82.22)[d]	60 (61.22)	179 (63.93)	99 (78.57)	805 (62.16)	618 (57.92)[e]
Non-Hispanic Black	15 (16.85)	95 (21.69)	1 (2.22)	10 (10.20)	17 (6.07)	7 (5.56)	217 (16.76)	107 (10.03)
Hispanic/Latinx	20 (22.47)	57 (13.01)	4 (8.89)	11 (11.22)	57 (20.36)	14 (11.11)	179 (13.82)	239 (22.40)
Asian	8 (8.99)	24 (5.48)	1 (2.22)	7 (7.14)	8 (2.86)	2 (1.59)	41 (3.17)	66 (6.19)
Other[f]	1 (1.12)	9 (2.05)	2 (4.44)	10 (10.20)	19 (6.79)	4 (3.17)	53 (4.09)	37 (3.47)
Chi-square (df), *p*-value[g]	0.159	<0.0001	0.014	0.005	0.003	<0.0001	35.7870 (4), <0.0001	–[h]
Education level								
High school degree or less	36 (36.36)	113 (24.41)	13 (28.89)	14 (13.46)	49 (17.07)	28 (21.71)	455 (32.22)	238 (21.66)
Some post–high school	26 (26.26)	135 (29.16)	14 (31.11)	26 (25.00)	77 (26.83)	32 (24.81)	463 (32.79)	279 (25.39)
College degree	26 (26.26)	115 (24.84)	8 (17.78)	34 (32.69)	93 (32.40)	36 (27.91)	302 (21.39)	349 (31.76)
Postgraduate studies	11 (11.11)	100 (21.60)	10 (22.22)	30 (28.85)	68 (23.69)	33 (25.58)	192 (13.60)	233 (21.20)
Chi-square (df), *p*-value	14.0321 (3), 0.003	8.1167 (3), 0.044	0.192	5.6174 (3), 0.132	3.1734 (3), 0.366	1.5837 (3), 0.663	90.7999 (3), <0.0001	–
Smoking status[i]								
No	66 (66.66)	315 (66.74)	24 (53.33)	79 (73.15)	187 (64.26)	82 (61.65)	782 (54.34)	815 (72.70)
Yes	34 (34.34)	157 (33.26)	21 (46.67)	29 (26.85)	104 (35.74)	51 (38.35)	657 (45.66)	306 (27.30)
Chi-square (df), *p*-value	2.0530 (1), 0.152	5.7335 (1), 0.017	8.0436 (1), 0.005	0.0098 (1), 0.921	7.9900 (1), 0.005	7.1273 (1), 0.008	84.9947 (1), <0.0001	–

Abbreviation: HINTS, Health Information National Trends Survey.
[a]Values are mean (standard deviation).
[b]Values are *n* (%).
[c]Green square indicates the *p*-value is significant for increase (as compared with the "No Chronic Disease" category) in one of the following ways: increased amount of minorities, increased education level, increased smoking.
[d]Red square indicates the *p*-value is significant for decrease (as compared with the "No Chronic Disease" category) in one of the following ways: decreased amount of minorities, decreased education level, decreased smoking.
[e]Yellow column distinguishes the control category for all two tailed *t*-tests.
[f]Other includes American Indian/Alaska Native, Pacific Islander, and multiple races.
[g]All Chi-square and *p*-values are given in reference to the "No Chronic Diseases" category as determined by two-tailed *t*-tests or Fisher's exact test for cells with a sample size less than 10 (no Chi-square value given in this case).
[h]Indicates no value was calculated, as "No Chronic Disease" was the control category.
[i]Smoking status "yes" defined as having smoked at least 100 cigarettes in lifetime.

Table 3 HIT usage among participants with and without chronic disease, HINTS 5 (Cycle 4)

	Diabetes ($n=102$)	Hypertension ($n=478$)	Cardiovascular disease ($n=45$)	Pulmonary disease ($n=108$)	Depression/ anxiety ($n=292$)	Cancer ($n=133$)	Comorbidities ($n=1,455$)	No chronic disease ($n=1,130$)
Internet usage								
Social media								
Yes	7 (7.53)[a]	42 (9.13)[b]	1 (2.44)	24 (22.64)[c]	59 (20.42)	14 (10.69)	182 (13.04)	146 (13.18)[d]
No	86 (92.47)	418 (90.87)	40 (97.56)	82 (77.36)	230 (79.58)	117 (89.31)	1214 (86.96)	962 (86.82)
Chi-square (df), *p*-value[e]	0.144	5.0438 (1), 0.025	0.052	7.1965 (1), 0.007	9.5914 (1), 0.002	0.6458 (1), 0.422	0.0109 (1), 0.917	–[f]
Online support forum								
Yes	7 (7.53)	25 (5.42)	1 (2.44)	21 (19.81)	45 (15.57)	11 (8.46)	118 (8.46)	87 (7.85)
No	86 (92.47)	436 (94.58)	40 (97.56)	85 (80.19)	244 (84.43)	119 (91.54)	1277 (91.54)	1021 (92.15)
Chi-square (df), *p*-value	1.000	2.8976 (1), 0.089	0.362	17.0726 (1), <0.0001	15.9619 (1), <0.0001	0.0593 (1), 0.808	0.0174 (1), 0.895	–
YouTube health video								
Yes	35 (37.23)	159 (34.42)	7 (17.07)	48 (45.28)	152 (52.41)	30 (22.90)	475 (34.05)	458 (41.34)
No	59 (62.77)	303 (65.58)	34 (82.93)	58 (54.72)	138 (47.59)	101 (77.10)	920 (65.95)	650 (58.66)
Chi-square (df), *p*-value	0.6026 (1), 0.438	6.5454 (1), 0.011	0.002	0.6201 (1), 0.431	11.4687 (1), 0.001	16.6766 (1), <0.0001	9.6553 (1), 0.002	–
Smartphone/tablet usage								
Look up health information								
Yes	60 (59.41)	303 (64.19)	31 (70.45)	84 (77.78)	248 (84.93)	95 (73.08)	960 (66.85)	838 (74.49)
No	41 (40.59)	169 (35.81)	13 (29.55)	24 (22.22)	44 (15.07)	35 (26.92)	476 (33.15)	287 (25.51)
Chi-square (df), *p*-value	10.7594 (1), 0.001	17.2709 (1), <0.0001	0.3613 (1), 0.548	0.5651 (1), 0.452	14.1210 (1), <0.0001	0.1218 (1), 0.727	10.3659 (1), 0.001	–
Communicate with doctor								
Yes	38 (39.58)	199 (42.61)	20 (45.45)	63 (58.88)	177 (60.82)	73 (56.15)	668 (46.84)	524 (46.66)
No	58 (60.42)	268 (57.39)	24 (54.55)	44 (41.12)	114 (39.18)	57 (43.85)	758 (53.16)	599 (53.34)
Chi-square (df), *p*-value	1.7828 (1), 0.182	2.1801 (1), 0.140	0.0248 (1), 0.875	5.8453 (1), 0.016	18.5476 (1), <0.0001	4.2093 (1), 0.040	0.3018 (1), 0.583	–
Health/wellness applications								
Yes	40 (51.28)	191 (50.26)	19 (59.38)	73 (72.28)	165 (61.57)	58 (53.21)	592 (53.19)	488 (47.61)
No	38 (48.72)	189 (49.74)	13 (40.63)	28 (27.72)	103 (38.43)	51 (46.79)	521 (46.81)	537 (52.39)
Chi-square (df), *p*-value	0.6890 (1), 0.406	3.8304 (1), 0.050	0.1330 (1), 0.715	9.8080 (1), 0.002	2.5630 (1), 0.109	0.3392 (1), 0.560	1.8879 (1), 0.169	–
Track progress on a goal								
Yes	35 (44.30)	169 (43.44)	12 (36.36)	59 (58.42)	155 (56.57)	46 (42.20)	444 (39.02)	402 (39.26)
No	44 (55.70)	220 (56.56)	21 (63.64)	42 (41.58)	119 (43.43)	63 (57.80)	694 (60.98)	622 (60.74)

(*Continued*)

Table 3 (*Continued*)

	Diabetes ($n = 102$)	Hypertension ($n = 478$)	Cardiovascular disease ($n = 45$)	Pulmonary disease ($n = 108$)	Depression/anxiety ($n = 292$)	Cancer ($n = 133$)	Comorbidities ($n = 1,455$)	No chronic disease ($n = 1,130$)
Chi-square (df), *p*-value	0.3215 (1), 0.571	1.9665 (1), 0.161	1.6223 (1), 0.203	4.2979 (1), 0.038	6.9430 (1), 0.008	1.1565 (1), 0.282	21.0377 (1), <0.0001	–
Make health care decisions								
Yes	34 (43.04)	146 (37.63)	9 (28.13)	40 (40.00)	143 (52.19)	49 (45.37)	453 (39.95)	402 (39.26)
No	45 (56.96)	242 (62.37)	23 (71.88)	60 (60.00)	131 (47.81)	59 (54.63)	681 (60.05)	622 (60.74)
Chi-square (df), *p*-value	0.4384 (1), 0.508	0.3144 (1), 0.575	0.269	0.0210 (1), 0.885	14.8410 (1), <0.0001	1.5230 (1), 0.217	0.2204 (1), 0.639	–
Electronic wearable device usage								
EWD[g] usage								
Yes	23 (23.00)	129 (27.27)	13 (29.55)	47 (43.93)	120 (41.38)	40 (30.77)	331 (23.13)	342 (30.45)
No	77 (77.00)	344 (72.73)	31 (70.45)	60 (56.07)	170 (58.62)	90 (69.23)	1100 (76.87)	781 (69.55)
Chi-square (df), *p*-value	2.4368 (1), 0.119	1.6193 (1), 0.203	0.0165 (1), 0.898	8.1984 (1), 0.004	12.5013 (1), <0.0001	0.0055 (1), 0.941	27.0398 (1), <0.0001	–
Frequency								
Daily	10 (43.48)	82 (64.57)	4 (30.77)	21 (44.68)	64 (53.78)	19 (47.50)	154 (46.95)	156 (46.02)
Almost daily	9 (39.13)	26 (20.47)	5 (38.46)	13 (27.66)	25 (21.01)	7 (17.50)	71 (21.65)	81 (23.89)
1–2 times per week	1 (4.35)	7 (5.51)	1 (7.69)	5 (10.64)	9 (7.56)	8 (20.00)	24 (7.32)	39 (11.50)
< 1 per week	2 (8.70)	3 (2.36)	1 (7.69)	5 (10.64)	9 (7.56)	3 (7.50)	26 (7.93)	29 (8.55)
Not in past month	1 (4.35)	9 (7.09)	2 (15.38)	3 (6.38)	12 (10.08)	3 (7.50)	53 (16.16)	34 (10.03)
Chi-square (df), *p*-value	0.536	0.003	0.618	0.907	0.615	0.596	10.3958 (4), 0.034	–
Online medical records								
Online medical record[h] usage								
Yes	36 (36.00)	198 (42.22)	16 (36.36)	47 (43.93)	141 (48.96)	63 (49.22)	618 (43.71)	408 (36.56)
No	64 (64.00)	271 (57.78)	28 (63.64)	60 (56.07)	147 (51.04)	65 (50.78)	796 (56.29)	708 (63.44)
Chi-square (df), *p*-value	0.0124 (1), 0.911	4.4770 (1), 0.034	0.0007 (1), 0.979	2.2677 (1), 0.132	14.7799 (1), <0.0001	7.8223 (1), 0.005	6.2549 (1), 0.012	–

Abbreviations: HINTS, Health Information National Trends Survey; HIT, health information technology.
[a]All values are given as *n* (%).
[b]Red square indicates the *p*-value is significant for decreased HIT use as compared with the “No Chronic Diseases” category.
[c]Green square indicates the *p*-value is significant for increased HIT use as compared with the “No Chronic Diseases” category.
[d]Yellow column distinguishes the control category for all two tailed *t*-tests.
[e]All Chi-square and *p*-values are given in reference to the “No Chronic Diseases” category as determined by two-tailed *t*-tests or Fisher’s exact test for cells with a sample size less than 10 (no Chi-square value given in this case).
[f]Indicates no value was calculated, as “No Chronic Disease” was the control category.
[g]EWD = electronic wearable device.
[h]Yes = one time or more in the past 12 months; no = never.

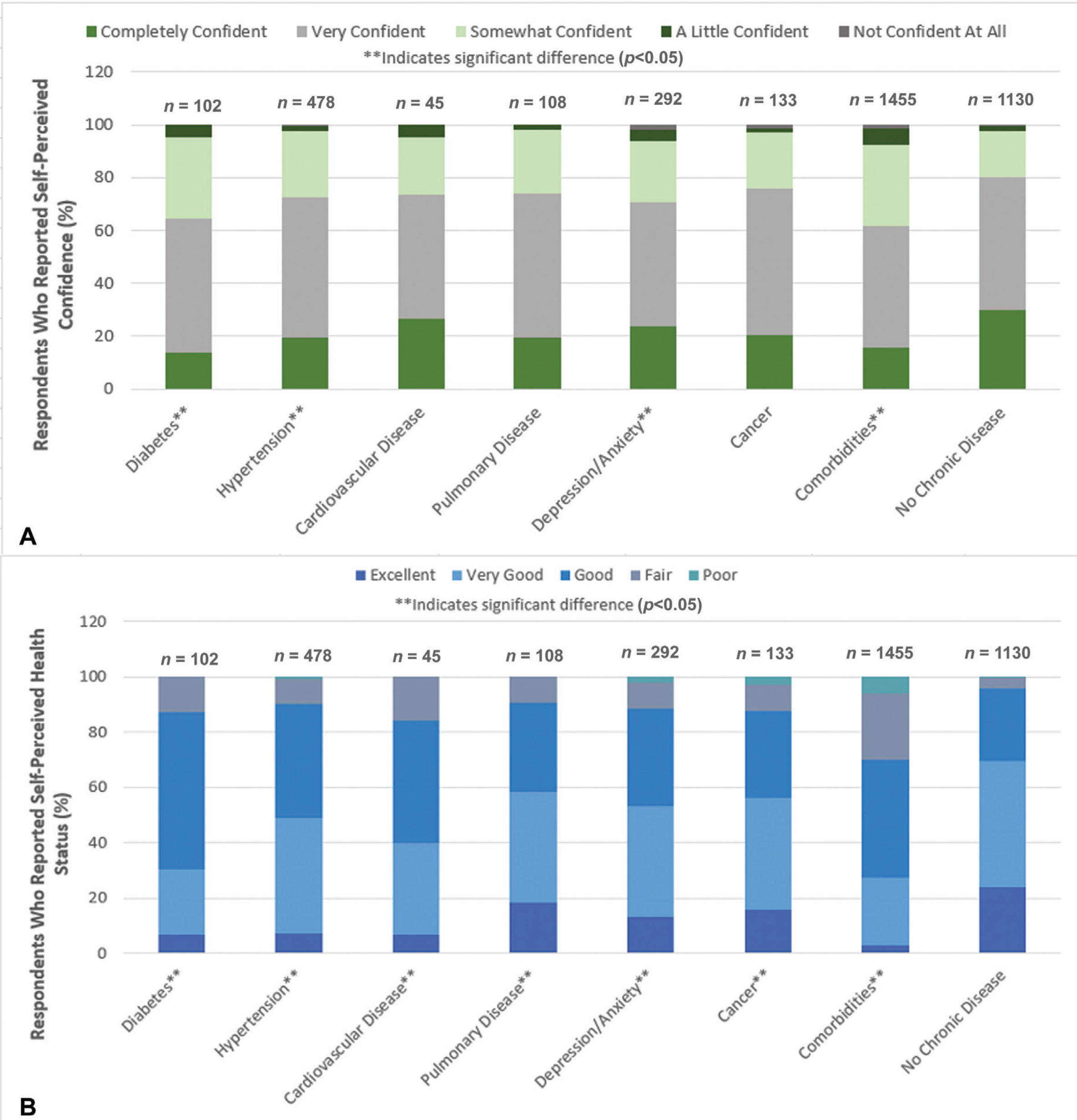

Fig. 1 (A) Figure shows participants' confidence in taking care of their own health by chronic disease. For each category (diabetes, hypertension, cardiovascular disease, pulmonary disease, depression, cancer, comorbidities, and no chronic disease), percentage of participants who reported confidence as "completely confident," "very confident," "somewhat confident," "a little confident," and "not confident at all" is depicted in stacked bar format. This data are from HINTS 5 Cycle 4 (2020). (B) Figure shows participants' self-perceived health status by chronic disease. For each category (diabetes, hypertension, cardiovascular disease, pulmonary disease, depression, cancer, comorbidities, and no chronic disease), percentage of participants who reported health as "excellent," "very good," "good," "fair," and "poor" is depicted in stacked bar format. This data are from HINTS 5 Cycle 4 (2020).

6.9% of patients with diabetes report their health status as "excellent" as compared with 23.9% of participants without chronic disease.

Health Information Technology Usage among Chronic Disease Patients

►Table 3 shows how HIT usage varies between each disease category, patients with comorbidities, and patients with no disease. Patients with diabetes, hypertension, cardiovascular disease, and comorbidities had several instances of significantly decreased HIT use (highlighted in red in ►Table 3). For example, patients with comorbidities had significantly decreased use of YouTube videos ($p = 0.002$), smartphones for looking up health information ($p = 0.001$), applications for tracking progress on goals ($p < 0.0001$), and electronic wearable devices ($p < 0.0001$) as compared with patients with no disease.

In contrast, participants with pulmonary disease and depression/anxiety, as well as some instances with cancer patients and hypertension patients, had significantly

Table 4 HIT usage by chronic disease and demographic predictors, HINTS 5 (Cycle 4)

	Health/wellness applications ($n = 3,171$)		YouTube health videos ($n = 3,728$)		Look up health information ($n = 3,828$)		Communicate with provider ($n = 3,796$)		Access online medical records ($n = 3,777$)	
	Odds ratio	*p*-Value	Odds ratio	*p*-Value	Odds ratio	*p*-Value	Odds ratio	*p*-Value	Odds ratio	*p*-Value
Age	0.969	<0.0001	0.968	<0.0001	0.962	<0.0001	0.982	<0.0001	0.986	<0.0001
Race/ethnicity										
Non-Hispanic White	Ref.[a]	–[b]	Ref.	–	Ref.	–	Ref.	–	Ref.	–
Non-Hispanic Black	1.036	0.775	1.611[c]	<0.0001	0.896	0.401	0.869	0.223	0.832	0.114
Hispanic/Latinx	0.809	0.067	1.651	<0.0001	0.784[d]	0.049	0.691	0.001	0.559	<0.0001
Asian	0.794	0.235	1.823	0.001	0.949	0.812	0.667	0.024	0.763	0.134
Other[e]	1.221	0.363	1.139	0.515	0.911	0.714	1.067	0.746	1.085	0.683
Education level										
High school degree or less	Ref.	–	Ref.	–	Ref.	–	Ref.	–	Ref.	–
Some post–high school education	1.593	<0.0001	1.521	<0.0001	2.438	<0.0001	1.927	<0.0001	2.038	<0.0001
College degree	1.919	<0.0001	1.793	<0.0001	3.830	<0.0001	2.897	<0.0001	3.473	<0.0001
Postgraduate	2.533	<0.0001	2.129	<0.0001	6.030	<0.0001	4.619	<0.0001	4.073	<0.0001
Self-reported health status										
Poor	Ref.	–	Ref.	–	Ref.	–	Ref.	–	Ref.	–
Fair	1.120	0.704	0.968	0.907	1.086	0.773	1.033	0.906	0.882	0.641
Good	1.210	0.516	1.025	0.930	1.196	0.527	1.083	0.766	1.065	0.814
Very good	1.318	0.363	1.031	0.914	1.147	0.640	1.240	0.435	0.874	0.625
Excellent	1.569	0.169	1.345	0.332	1.072	0.831	1.333	0.335	0.877	0.659
Self-reported confidence										
Not confident at all	Ref.	–	Ref.	–	Ref.	–	Ref.	–	Ref.	–
A little confident	1.808	0.262	0.909	0.841	0.515	0.213	0.803	0.641	1.063	0.900
Somewhat confident	2.210	0.107	1.276	0.584	0.842	0.733	1.117	0.800	1.057	0.904
Very confident	2.452	0.069	1.044	0.924	0.670	0.430	1.214	0.659	1.259	0.617
Completely confident	2.920	0.032	1.003	0.995	0.771	0.612	1.279	0.580	1.449	0.427
Diabetes										
No	Ref.		Ref.	–	Ref.	–	Ref.	–	Ref.	–
Yes	1.201	0.099	0.947	0.613	0.982	0.872	1.191	0.086	1.105	0.331

Table 4 (*Continued*)

	Health/wellness applications ($n = 3,171$)		YouTube health videos ($n = 3,728$)		Look up health information ($n = 3,828$)		Communicate with provider ($n = 3,796$)		Access online medical records ($n = 3,777$)	
	Odds ratio	*p*-Value	Odds ratio	*p*-Value	Odds ratio	*p*-Value	Odds ratio	*p*-Value	Odds ratio	*p*-Value
Hypertension										
No	Ref.	–	Ref.	–	Ref.	–	Ref.	–	Ref.	–
Yes	1.035	0.711	1.129	0.182	0.927	0.442	1.092	0.316	1.425	<0.0001
Cardiovascular disease										
No	Ref.	–	Ref.	–	Ref.	–	Ref.	–	Ref.	–
Yes	1.493	0.008	1.005	0.974	1.198	0.204	0.864	0.270	1.044	0.745
Pulmonary disease										
No	Ref.	–	Ref.	–	Ref.	–	Ref.	–	Ref.	–
Yes	1.561	<0.0001	1.039	0.736	1.112	0.416	1.343	0.007	1.253	0.038
Depression/anxiety										
No	Ref.	–	Ref.	–	Ref.	–	Ref.	–	Ref.	–
Yes	1.182	0.087	1.397	<0.0001	1.811	<0.0001	1.473	<0.0001	1.379	<0.0001
Cancer										
No	Ref.	–	Ref.	–	Ref.	–	Ref.	–	Ref.	–
Yes	1.450	0.001	1.093	0.429	1.333	0.018	1.573	<0.0001	1.582	<0.0001
Smoking status[f]										
No	Ref.	–	Ref.	–	Ref.	–	Ref.	–	Ref.	–
Yes	0.906	0.257	1.029	0.730	1.085	0.379	1.037	0.657	0.891	0.157

Abbreviations: HINTS, Health Information National Trends Survey; HIT, health information technology.
[a]Ref. = reference group.
[b]A dash indicates that no value was calculated.
[c]A green square indicates the odds ratio is increased as compared with the reference value.
[d]A red square indicates the odds ratio is decreased as compared with the reference value.
[e]Other includes American Indian/Alaska Native, Pacific Islander, and multiple races.
[f]Smoking status "yes" defined as having smoked at least 100 cigarettes in lifetime.

increased use of several HIT tools as compared with those without disease. For example, patients with depression had significantly increased use of social media ($p = 0.002$), online health forums ($p < 0.0001$), YouTube videos ($p = 0.001$), smartphones for looking up health information ($p < 0.0001$), smartphones for communicating with providers ($p < 0.0001$), applications for tracking progress on a goal ($p = 0.008$), smartphones for making health care decisions ($p < 0.0001$), electronic wearable devices ($p < 0.0001$), and online medical records ($p < 0.0001$) as compared with patients with no disease.

Trends over Time (2014–2020) in Health Information Technology Usage among Chronic Disease Patients

►Fig. 2 shows how HIT usage among chronic disease patients changed between the years 2014 and 2020. In general, HIT use increased across all HIT types and all chronic disease categories in the timeframe examined, with some fluctuations. Note that data regarding YouTube videos, looking up information, and communicating with providers was unavailable in 2014 and medical record access data in 2018 was excluded due to response errors.

Predicting Health Information Technology Usage by Chronic Disease Diagnosis

►Table 4 depicts five separate multivariate logistic regression models analyzing how HIT usage variables are associated with chronic disease. These models give a better understanding of factors associated with HIT use in chronic disease patients when controlling for age, race/ethnicity, educational attainment, smoking status, and comorbidities.

Patients with depression/anxiety still have increased likelihood of using many HIT tools when controlling for social confounders. For example, these patients have an increased odds of 39.7% for watching YouTube health videos ($p < 0.0001$), 47.3% for communicating with providers ($p < 0.0001$), 37.9% for accessing online medical records ($p < 0.0001$), and 81.1% for looking up health information ($p < 0.0001$) as compared with patients without disease, controlling for age, race/ethnicity, education, health status, health confidence, smoking, and comorbidities. Patients with pulmonary disease have a significantly increased likelihood of using health applications and communicating with providers as compared with those without disease, controlling for the same factors.

Patients with cancer also have significantly increased likelihood of using many HIT tools when controlling for demographic factors. Specifically, between 30 to 60% of these patients have increased likelihood of using health applications, looking up information, communicating with providers, and accessing online medical records as compared with participants without disease, controlling for age, race/ethnicity, health status, confidence, education, smoking, and comorbidities.

Finally, note that age has a significant impact on HIT usage, as expected. For example, of participants who report using health/wellness applications, for every 1 year increase in age, there is a 3% decreased odds of using this HIT tool, controlling for race/ethnicity, education level, chronic disease, and smoking status. This corresponds to an odds ratio of 0.74 for 10 years which is a substantially sized effect. This points to a significant gap between older participants' HIT usage levels and younger participants' usage, regardless of disease status.

Discussion

This study provides an important perspective around HIT utilization in the United States across a representative population over time looking closely at individuals with chronic disease. We observed that patients across all chronic disease categories compared with those without disease report lower self-perceptions of health and lower confidence in taking care of their own health. These results align with findings of other studies conducted in the United States, Canada, and Spain suggesting that patients with chronic diseases have lower self-esteem, self-efficacy, and confidence.[15,16] This showcases a need for strategies to improve patients' health and confidence in taking care of themselves. Applications of HIT tools could be one such strategy, for example, by equipping patients with information delivered through applications, wearable devices, accessible health videos, and more.

Interestingly, we observed that patients with different chronic diseases had differing degrees of HIT usage. Notably, patients with pulmonary disease, depression, and cancer tended to have increased use of many HIT tools, whereas patients in other chronic disease groups did not. This observation remained even after controlling for demographic factors. Further analysis could be done to understand the underlying factors that influence these patients to utilize HIT more than other populations.

Tool design, functionality, and availability are examples of a motivating factor, including tools tailored to these patients, with more engaging layouts that facilitate regular use. For example, many HIT platforms exist to engage depression patients in cognitive behavioral therapy (CBT). Previous review studies have shown the sheer amount of online CBT tools, the wide range in styles of therapy, and the statistically significant improvement in outcomes for patients engaging with these tools.[17,18] With such effective tools already available for depression patients, it makes sense that more patients with depression are engaging with HIT. It would prove beneficial for patients with other illnesses to learn from these successful tools and develop HIT methods incorporating successful features.

Differences in the disease management or length of chronic illness may also impact patient engagement with HIT. While certain chronic diseases typically develop in adulthood; pulmonary disease and depression may have earlier occurrence or develop at a younger age. Additionally, provider input in HIT as a part of disease management has an impact on usage; studies have shown that when providers encourage online medical record use, patient usage goes up, but many providers are not encouraging use, even in the era of novel coronavirus disease 2019 (COVID-19) and

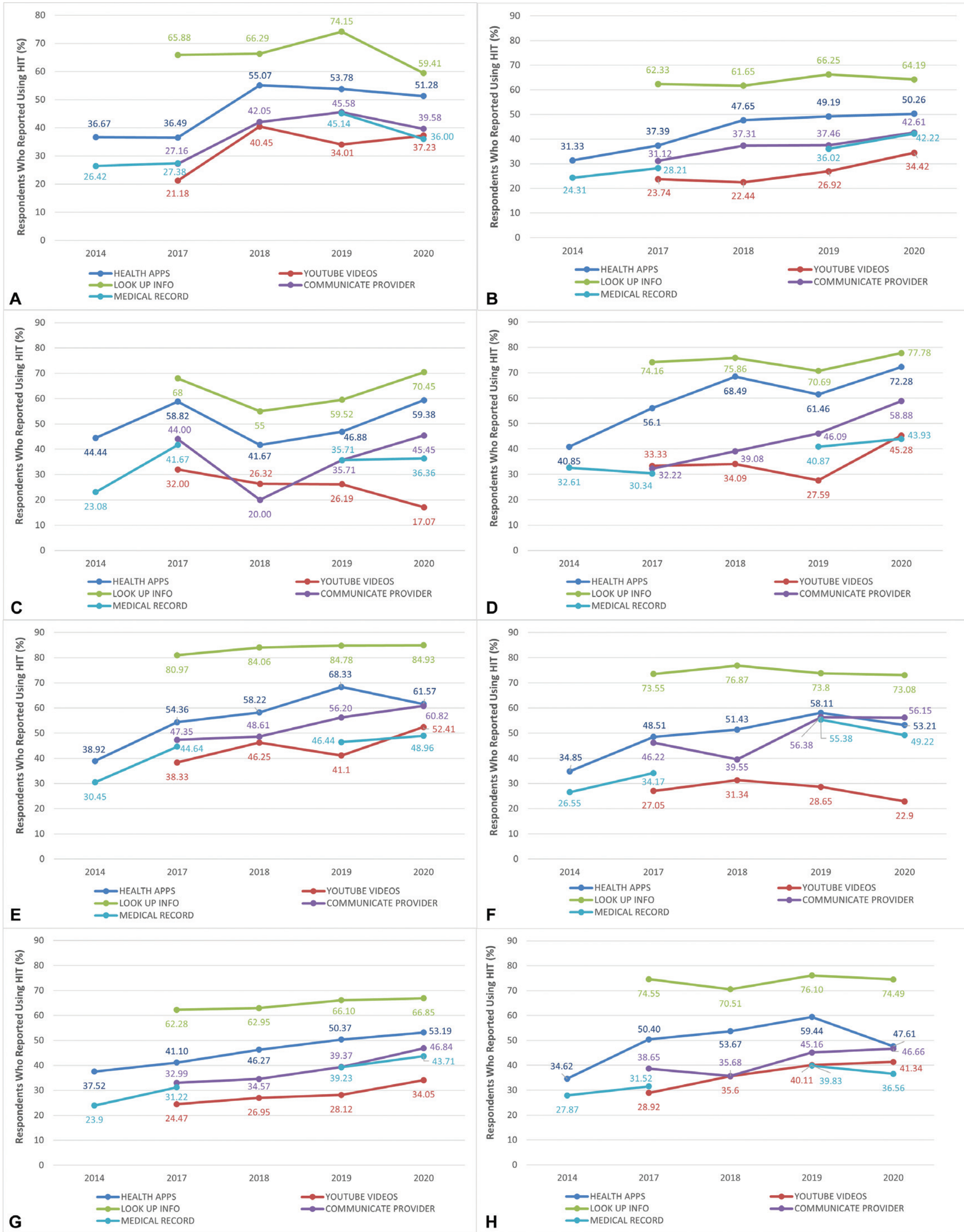

Fig. 2 (**A**) Figure shows trends in usage of health applications, YouTube health videos, internet for looking up information, smartphones for communicating with providers, and online medical records between 2014–2020 among patients with diabetes. (**B**) Figure shows trends in usage of health applications, YouTube health videos, internet for looking up information, smartphones for communicating with providers, and online medical records between 2014–2020 among patients with hypertension. (**C**) Figure shows trends in usage of health applications, YouTube health videos, internet for looking up information, smartphones for communicating with providers, and online medical records between 2014–2020 among patients with cardiovascular disease. (**D**) Figure shows trends in usage of health applications, YouTube health videos, internet for looking up information, smartphones for communicating with providers, and online medical records between 2014–2020 among patients with pulmonary disease. (**E**) Figure shows trends in usage of health applications, YouTube health videos, internet for looking up information, smartphones for communicating with providers, and online medical records between 2014–2020 among patients with depression/anxiety. (**F**) Figure shows trends in usage of health applications, YouTube health videos, internet for looking up information, smartphones for communicating with providers, and online medical records between 2014–2020 among patients with cancer. (**G**) Figure shows trends in usage of health applications, YouTube health videos, internet for looking up information, smartphones for communicating with providers, and online medical records between 2014–2020 among patients with comorbidities. (**H**) Figure shows trends in usage of health applications, YouTube health videos, internet for looking up information, smartphones for communicating with providers, and online medical records between 2014–2020 among patients with no chronic disease. HIT, health information technology.

telehealth.[19] Ultimately, understanding the wide range of underlying factors which motivate patients to utilize HIT and engage in disease management may help in translating efficacious solutions to other disease categories.

Despite evidence of HIT solutions improving chronic disease management,[4–6] for hypertension, cardiovascular disease, and diabetic patients, similar HIT usage to those without disease was observed across all HIT categories. This is particularly of interest, since these disease populations are primary targets for HIT interventions.

It is important to keep in mind that demographic factors are a huge driver of HIT use.[8,9] Many patients with chronic disease are minorities and/or have lower educational attainment than those without disease (►Table 2), and this can greatly influence their access to HIT tools. Additionally, older participants have significantly decreased HIT usage, regardless of chronic disease status. Although these factors are controlled for in our logistic regression models, it is important to recognize that when improving tools/engagement for people with chronic disease, equal access and health/technology literacy are important aspects of increasing engagement.

Finally, while HIT use has generally increased over the past 6 years across all HIT types studied and all chronic disease categories, the amount of increase fluctuated and varied greatly across different forms of HIT solutions. For example, similar to all other chronic disease conditions, hypertensive patients in this dataset increased their access to online medical records, from only 24.3% in 2014 to 42.22% in 2020. On the other hand, only modest or flat increases in the use of internet for looking up health information were seen in all populations, illustrated by cardiovascular patients with 68.0% in 2014 to 70.5% in 2020. Additionally, some HIT solutions remain at less than 50% penetrance in 2020 including YouTube health videos and online medical record access. These trends demonstrate that while progress has been made in increasing adoptions of HIT solutions over the past 6 years, many patients, still, do not utilize these tools, perhaps partly due to larger social issues such as cost and low health literacy.[20]

Future Research and Implications

Additional research is necessary to understand how HIT tools can be improved for diabetic, hypertensive, and cardiovascular disease patients. While the HINTS questionnaire helps us understand overall trends in usage, it still remains unclear why pulmonary disease, depression, and cancer patients have increased likelihood of HIT usage. Future work could include conducting interviews with patients in these disease categories who report using HIT to understand more details about their health history, health care interaction, and HIT usage patterns. Additionally, this work could be expanded to study the tools that these patients report using to determine which features (e.g., user design and experience) of these tools facilitate differential engagement and try to implement them in HIT for other patients.

At the national level, policy changes have the ability to influence increased access to HIT. As seen in our analysis, there are many tools for which less than 50% of patients report use. Barriers to high usage rates could include limited internet, smartphone, and device access (due to cost), as well as lack of education on how to best utilize these tools.[20] Policy changes to increase HIT access may help improve outcomes for chronic disease management.

Limitations

There are several limitations to consider for this study. First, the HINTS survey data are cross-sectional, and thus the results of this study indicate correlation rather than causation. Second, the HINTS survey overall has a relatively low response rate (~37%) and hence some nonresponse bias may have been introduced into the data. Third, since the questionnaire has evolved over time, data from 2014 and earlier did not include relevant questions to this study, and hence HIT usage trends could only be examined in a 6-year timeframe, and in 2014, data regarding several types of HIT solutions were missing. Furthermore, missing data in 2018 regarding online medical record access resulted in exclusion of that data.

Another major limitation of this study was inability to account for physical activity level/health status of participants as a confounder, as this could influence how much HIT they use. Additionally, other increasingly popular forms of HIT functionality, including virtual reality and remote patient monitoring, as well as other chronic conditions (e.g., stroke deficits and kidney conditions), could not be analyzed through HINTS.

One other important aspect that this study does not cover are the effects of the COVID-19 pandemic which introduced profound changes in our society, including a rapid shift in overall cultural acceptance of HIT for various health care interactions. Unfortunately, the HINTS survey data from 2020 do not specifically explore changes in HIT use among these populations as a consequence of the pandemic. Finally, there are limitations to evaluating HIT usage and fully understanding the many ways in which HIT can be used through a population-based survey which does not go into depth regarding the overall design of HIT tools or individual nuances in HIT usage.

Conclusion

Increased usage of available HIT tools could provide benefit for management of chronic disease. This study addresses a gap in the literature regarding how HIT usage varies among chronic disease patients to understand the current state of HIT solution utilization. As observed in this study, chronic disease patients lack confidence in taking care of their own health and have reduced perceptions of health. Additionally, HIT usage is not equal among chronic disease patients, with pulmonary disease, depression, and cancer patients utilizing HIT tools at greater rates. Our study thus highlights a need to understand what aspects of HIT tools geared toward depression and pulmonary patients increase engagement and translate this over to tools for other chronic disease profiles. Furthermore, while HIT use has generally increased over the past 6 years, this increase has not been equal across HIT types.

Clinical Relevance Statement

This study demonstrates that not all chronic disease patients equally utilize HIT tools and can guide future physicians in understanding why these differences occur. Practitioners can use this knowledge to help their patients with diabetes, high blood pressure, or cardiovascular conditions increase their use of HIT and provide education regarding the benefits of HIT to improve outcomes.

Multiple Choice Questions

1. Patients in which of the following groups had significantly increased use of HIT tools when controlling for sociodemographic factors and comorbidities?
   a. Diabetes, hypertension, and cardiovascular disease
   b. Pulmonary disease, depression/anxiety, and cancer
   c. Pulmonary disease, diabetes, and cancer
   d. Depression/anxiety, hypertension, and cardiovascular disease

   Correct Answer: The correct answer is option b. As illustrated by analyses from this study, patients with pulmonary disease, depression/anxiety, and cancer have significantly increased use of many HIT tools when controlling for sociodemographic factors and comorbidities. Specifically, patients with pulmonary disease have significantly increased use of health/wellness applications and communicating with providers. Patients with depression/anxiety have significantly increased use of YouTube health videos, looking up health information, communicating with providers, and online medical record access. And cancer patients have significantly increased use of health/wellness applications, looking up information, communicating with providers, and online medical record access. In contrast, patients with diabetes, hypertension, and cardiovascular disease do not have significantly increased use of most HIT tools examined as compared with patients with these diseases.

2. Which of the following trends in HIT use across the timeframe 2014–2020 is correct?
   a. Today, all HIT tools are above 50% penetrance.
   b. A majority of patients utilize YouTube videos consistently from 2014–2020.
   c. Online medical record access generally increased across the timeframe examined for all disease categories.
   d. Use of all HIT tools increased equally during the timeframe examined for all disease categories.

   Correct Answer: The correct answer is option c. As illustrated in ►Fig. 2, online medical record access generally increased between 2014–2020 for all disease categories. Indeed, some categories (e.g., hypertension) saw dramatic increases in online medical record use, from 24.0% in 2014 to 41.6% in 2020. Option (a) is incorrect because some tools remain below 50% penetrance today, for example, YouTube health videos and online medical record access. Option (b) is incorrect because less than 50% of patients use YouTube videos in the timeframe examined. Option (d) is incorrect because, although use of all HIT tools did generally increase during the timeframe examined, the amount of increase was quite variable between different tools and disease categories.

Protection of Human and Animal Subjects

No human and/or animal subjects were included in the study. All data obtained from the HINTS survey were deidentified.

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Conflict of Interest

None declared.

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