Brief Communications

Sharing patient-generated data with healthcare providers: findings from a 2019 national survey

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ABSTRACT

Objective: Our study estimates the prevalence and predictors of wearable device adoption and data sharing with healthcare providers in a nationally representative sample.

Materials and Methods: Data were obtained from the 2019 Health Information National Trend Survey. We conducted multivariable logistic regression to examine predictors of device adoption and data sharing.

Results: The sample contained 4159 individuals, 29.9% of whom had adopted a wearable device in 2019. Among adopters, 46.3% had shared data with their provider. Individuals with diabetes (odds ratio [OR], 2.39; 95% CI, 1.66–3.45; $P < .0001$), hypertension (OR, 2.80; 95% CI, 2.12–3.70; $P < .0001$), and multiple chronic conditions (OR, 1.55; 95% CI, 1.03–2.32; $P < .0001$) had significantly higher odds of wearable device adoption. Individuals with a usual source of care (OR, 2.44; 95% CI, 1.95–3.04; $P < .0001$), diabetes (OR, 1.66; 95% CI, 1.32–2.08; $P < .0001$), and hypertension (OR, 1.78; 95% CI, 1.44–2.20; $P < .0001$) had significantly higher odds of sharing data with providers.

Discussion: A third of individuals adopted a wearable medical device and nearly 50% of individuals who owned a device shared data with a provider in 2019. Patients with certain conditions, such as diabetes and hypertension, were more likely to adopt devices and share data with providers. Social determinants of health, such as income and usual source of care, negatively affected wearable device adoption and data sharing, similarly to other consumer health technologies.

Conclusions: Wearable device adoption and data sharing with providers may be more common than prior studies have reported; however, digital disparities were noted. Studies are needed that test implementation strategies to expand wearable device use and data sharing into care delivery.

Key words: patient-generated data, patient-generated health data, wearable device, wearable technology

INTRODUCTION

Wearable technologies can facilitate sharing of patient-generated data (PGD), such as blood pressure or glucose data, with healthcare providers. Providers have noted benefits of integrating PGD into clinical care, such as monitoring patients in real time and accessing information that would otherwise not be available between visits.^{1–3}

Providers' use of PGD in clinical care can improve patient outcomes, such as blood pressure and glycemic control, detection of adverse events, such as hypoglycemia, and reduce unnecessary hospitalizations and healthcare costs.^{4–8} Despite the benefits, there are substantial barriers that may prevent routine sharing of PGD.^{9–18}

Prior studies have documented system-level barriers to sharing PGD with providers, such as lack of reimbursement, lack of standardized measurement, inability to integrate data in the electronic health record, and inability to combine PGD with other data.^{9,11,13–15,17,18}

Glucose data, for example, may be easier to interpret alongside information on patients' medication adherence, diet, and physical activity. Providers note barriers to PGD usage, such as difficulty with data interpretation and data quality concerns.^{19–21} There is also evidence of patient-level barriers.^{10,12,16,22} Previous research has suggested that patients who are younger, White, non-Hispanic, married, or English-speaking, or have higher income and/or education are more likely to share PGD with providers.^{16,22} To date, all US-based studies examining wearable technology adoption and PGD sharing have been limited to single-site studies, making it difficult to discern how many patients share PGD with providers nationally. A recent report (n = 4272) found that 41% of Americans were willing to share PGD with providers but the report did not assess whether PGD was shared with providers.²³ In recent years, technology use in healthcare, such as smartphones, patient portals, and telemedicine, has rapidly expanded;^{24–26} therefore, it is timely to assess whether PGD adoption and data sharing have made similar gains. Further, a national snapshot of PGD use in healthcare could inform healthcare system planning around consumer health informatics, such as how PGD can be leveraged to support patient engagement, and whether integration of PGD into routine care will require implementation strategies to overcome digital disparities.

To address this gap, our study estimates the prevalence and predictors of wearable device adoption and data sharing in a nationally representative sample.

MATERIALS AND METHODS

Data were obtained from the 2019 Health Information National Trend Survey (HINTS), which is administered by the National Cancer Institute (NCI). The HINTS collects information on individuals' use of health information technologies, including wearable device adoption and data sharing with a healthcare provider. The sampling frame includes all civilian, non-institutionalized adults (age over 18) with nonvacant US residential addresses and is considered nationally representative. NCI uses a stratified sampling strategy by dividing all addresses into high- and low-minority strata based on census tract characteristics and oversamples the high-minority stratum.

The HINTS contains a question on wearable medical device adoption that asks, "In the last 12 months, have you used an electronic medical device to monitor or track your health. For example, a glucometer or a blood pressure device." This question was added in 2019 and is not available in prior HINTS years. The survey then asks whether the participant has shared health information from the device with a healthcare provider within the last 12 months. The

survey also includes demographic questions that are typically associated with technology adoption (eg, age, gender, race/ethnicity, income, education, insurance, usual source of care) and health status (eg, multiple chronic conditions [MCCs]).^{16,22} A paper-based survey was administered by mail in English and Spanish. The survey response rate was 30.3%.

We compared wearable medical device adoption and data sharing based on sample characteristics using Stata (version 16). We conducted multivariable logistic regression to examine predictors of wearable device adoption and data sharing. We applied sampling and jackknife replicate weights to adjust for complex survey design and develop nationally representative estimates. We used complete case analysis to deal with missing data, which was minimal (less than 6% for each variable). The Advarra Institutional Review Board exempted this study.

RESULTS

The sample contained 4159 individuals, of whom 29.9% had adopted a wearable medical device in 2019 (Table 1). Among adopters, 46.3% had shared PGD with their healthcare provider.

In the multivariable analyses, individuals with Hispanic ethnicity (odds ratio [OR], 1.26; 95% CI, 1.04–2.12; $P = .031$), a usual source of care (OR, 2.24; 95% CI, 1.56–3.22; $P < .0001$), diabetes (OR, 2.39; 95% CI, 1.66–3.45; $P < .0001$), hypertension (OR, 2.80; 95% CI, 2.12–3.70; $P < .0001$), and multiple chronic conditions (OR, 1.55; 95% CI, 1.03–2.32; $P < .0001$) had significantly higher odds of device adoption holding all else constant (Table 2). Individuals with household income of \$50 000–\$74 999 (OR, 1.26; 95% CI, 1.07–2.54; $P = .020$) and \$75 000+ (OR, 1.75; 95% CI, 1.20–2.54; $P = .004$) had significantly higher odds of device adoption compared with individuals who had a household income less than \$20 000 annually.

Among adopters, individuals with Black race (OR, 1.27; 95% CI, 1.03–1.58; $P = .028$), insurance (OR, 2.18; 95% CI, 1.23–3.86; $P = .008$), a usual source of care (OR, 2.44; 95% CI, 1.95–3.04; $P < .0001$), diabetes (OR, 1.66; 95% CI, 1.32–2.08; $P < .0001$), and hypertension (OR, 1.78; 95% CI, 1.44–2.20; $P < .0001$) had significantly higher odds of sharing PGD with a provider holding all else constant (Table 2). Individuals with household income of \$35 000–\$49 999 (OR, 1.40; 95% CI, 1.11–1.98; $P = .035$), \$50 000–\$74 999 (OR, 1.48; 95% CI, 1.14–1.98; $P = .008$) and \$75 000+ (OR, 1.50; 95% CI, 1.23–3.86; $P = .004$) had significantly higher odds of sharing PGD with a provider compared with individuals with household income less than \$20 000 annually.

DISCUSSION

The goal of this study was to estimate the prevalence and predictors of wearable device adoption and data sharing in a nationally representative sample. Overall, a third of individuals adopted a wearable device and about 45% of device owners shared PGD with their healthcare provider in 2019. We also found that certain patients, such as patients with diabetes or hypertension, higher income, or a usual source of care, were more likely to adopt wearable devices and share PGD with providers.

Prior studies reported low rates of wearable device adoption (<20%) and PGD sharing with a healthcare provider (<5%).^{22,23,27} For example, a recent poll found that 21% of adults own an activity tracker.²³ This study suggests that device adoption may be more

Table 1. Sample characteristics

Characteristic	All patients n = 4159 W = 198 306 360	Adopters ^a n = 1244 W = 49 959 328	P value	Shared data ^a n = 576 W = 24 093 091	P value
Age, mean (SD), y	55.73 (16.61)	61.16 (14.67)	<.0001	61.10 (14.13)	.829
Gender, no. (%)					
Male	1,803 (43.35)	570 (45.82)	.008	259 (44.97)	.290
Female	2356 (56.65)	674 (54.18)		317 (55.03)	
Race, no. (%)					
Black	698 (16.78)	236 (18.97)	.017	113 (19.62)	.693
White	3461 (83.22)	1008 (81.03)		463 (80.38)	
Ethnicity, no. (%)					
Hispanic	613 (14.74)	196 (15.76)	.998	78 (13.54)	.050
Non-Hispanic	3546 (85.26)	1048 (84.24)		498 (86.46)	
Education, No. (%)					
High school diploma or less	2105 (50.61)	680 (54.66)	.001	295 (51.22)	.126
College degree	1184 (28.47)	305 (24.52)		152 (26.39)	
Postgraduate	870 (20.92)	259 (20.82)		129 (22.40)	
Income, no. (%)					
Less than \$20 000	708 (17.02)	225 (18.09)	.009	90 (15.62)	.159
\$20 000–\$34 999	516 (12.41)	173 (13.91)		68 (11.81)	
\$35 000–\$49 999	531 (12.77)	167 (13.42)		74 (12.85)	
\$50 000–\$74 999	750 (18.03)	236 (18.97)		114 (19.79)	
\$75 000 or more	1654 (39.77)	443 (35.61)		230 (39.93)	
Insured, no. (%)					
Yes	3938 (94.69)	1202 (96.62)	<.0001	565 (98.09)	.004
No	221 (5.31)	42 (3.38)		11 (1.91)	
Usual source of care, no. (%)					
Yes	2959 (71.15)	1033 (83.04)	<.0001	505 (87.67)	<.0001
No	1200 (28.85)	211 (16.96)		71 (12.33)	
Diabetes, no. (%)					
Yes	882 (21.21)	503 (40.43)	<.0001	244 (42.36)	.188
No	3277 (78.79)	741 (59.57)		332 (57.64)	
Hypertension, no. (%)					
Yes	1805 (43.40)	871 (70.02)	<.0001	410 (71.18)	.313
No	2354 (56.60)	373 (29.98)		166 (28.82)	
Cancer history, no. (%)					
Yes	645 (15.51)	255 (20.50)	<.0001	123 (21.35)	.014
No	3514 (84.49)	989 (79.50)		453 (78.65)	
Multiple chronic conditions, no. (%)					
Yes	1267 (30.46)	664 (53.38)	<.0001	313 (54.34)	.214
No	2892 (69.54)	580 (46.62)		263 (45.66)	

^aPearson's χ^2 tests and *t* tests were conducted to compare adopters with nonadopters and to compare individuals who shared data with those who did not share data with a provider.

common, which may be due to differences in measurement (past studies examine activity trackers only^{16,22}) or advances in technology and improved insurance reimbursement for certain devices.^{28–30} Our study found a rate of PGD sharing with their providers that was higher than expected. A 2013 report found that 34% of patients who tracked health data (eg, paper logs and wearable devices) shared that data with another person; half of those individuals had shared data with a provider.³¹ This suggests that although there are substantial barriers to sharing PGD, some healthcare systems have found ways to integrate PGD into care delivery. Further research is needed to understand how data sharing occurs (eg, via a patient portal, manual uploads, mobile applications, recording values, and sharing a report) and what strategies providers have used to overcome barriers (eg, provider recommendations to increase the likelihood of data sharing³²).

Study findings suggest that access to wearable devices and the ability to share PGD with providers vary across patients. Patients with

certain conditions, such as hypertension and diabetes, were more likely to adopt wearable devices and share PGD with providers while patients with other conditions, such as a cancer history, were less likely. This may be due to underutilization of wearable devices in oncology care and system-level barriers (eg, variable reimbursement for the use of devices to monitor cancer-related symptoms).^{33,34} Our study found that patients with lower income and lack of a usual source of care were less likely to adopt wearable devices and share PGD with providers. This finding is similar to prior studies suggesting that financial resources and healthcare access affect wearable device adoption.^{16,22,23} In contrast to prior work,^{16,22} our study found that older age was associated with device adoption and data sharing, which may be due to differences in the type of device measured. Our study assessed wearable device adoption broadly whereas prior studies focused on activity trackers.^{16,22} It is possible that younger populations are more likely to use activity trackers but not necessarily other devices (eg, continuous glucose monitors). Further research is needed

Table 2. Predictors of wearable device adoption and data sharing

Predictor	Wearable device adoption n = 4159 W = 198 306 360			Wearable data sharing n = 1193 W = 47 809 348		
	OR	95% CI	P value	OR	95% CI	P value
Age	1.00	0.99–1.02	.273	1.00	0.99–1.00	.083
Male gender	1.02	0.71–1.46	.903	0.82	0.69–0.96	.017
Black race	1.11	0.68–1.82	.670	1.27	1.03–1.58	.028
Hispanic ethnicity	1.48	1.04–2.12	.031	1.05	0.82–1.32	.750
Education						
High school diploma or less (reference)						
College degree	0.87	0.62–1.23	.431	1.11	0.91–1.35	.301
Postgraduate	0.86	0.61–1.23	.412	1.16	0.93–1.45	.198
Income						
Less than \$20 000 (reference)						
\$20 000–\$34 999	1.48	0.97–2.28	.067	1.24	0.90–1.70	.193
\$35 000–\$49 999	1.26	0.62–2.55	.516	1.40	1.02–1.90	.035
\$50 000–\$74 999	1.49	1.07–2.08	.020	1.48	1.11–1.98	.008
\$75 000 or more	1.75	1.20–2.54	.004	1.50	1.14–1.98	.004
Insured	0.72	0.37–1.42	.338	2.18	1.23–3.86	.008
Has a usual source of care	2.24	1.56–3.22	<.0001	2.44	1.95–3.04	<.0001
Presence of diabetes	2.39	1.66–3.45	<.0001	1.66	1.32–2.08	<.0001
Presence of hypertension	2.80	2.12–3.70	<.0001	1.78	1.44–2.20	<.0001
Cancer history	1.35	0.70–2.63	.362	0.93	0.58–1.49	.756
Presence of multiple chronic conditions	1.55	1.03–2.32	.034	1.15	0.90–1.48	.251

to understand age-related differences in device adoption and data sharing. A recent qualitative study reported that age-related differences may be caused by device complexity, such as requiring a lot of information for account set-up.³⁵

Our study found inconsistencies in device adoption and data sharing. Patients with MCCs were more likely to adopt devices but not more likely to share data with healthcare providers. This finding contrasts with a prior report that found patients with MCCs were more likely to track health data and share data with another individual.³¹ The prior study was descriptive, however, and did not control for the influence of other patient-level factors. It is possible that type of condition, such as diabetes or hypertension, where self-monitoring is well established as a strategy for disease management,³⁶ plays a larger role in data sharing with providers than the number of chronic conditions. For conditions like cancer, the evidence regarding wearable devices and data sharing with providers is still emerging.³⁷ Similarly, findings by race and ethnicity were inconsistent.

A 2020 report found that Hispanic patients were more likely to adopt wearable activity trackers (26% vs 20%) and were more willing to share data with providers compared with non-Hispanic White patients (49% vs 39%). Our study found that Hispanic patients were more likely to adopt devices but less likely to share data with providers. This could be due to measurement error (eg, underreporting of data sharing) or due to systematic disparities in healthcare access experienced by Hispanic patients.^{38–40} While our model accounts for some disparities in access, such as insurance and usual source of care, it cannot account for factors such as medical mistrust or discrimination based on ethnicity, language, or immigration status.⁴¹ Further, we did not observe differences in device adoption based on race, which is consistent with a recent report that found activity tracker adoption was similar for Black and White patients (23% vs 20%).²³ Consistent with our work, the report found that Black patients were more willing to share PGD with providers compared with White patients (46% vs 39%). This differs from past

single-site studies that document racial and ethnic disparities in device adoption and data sharing.^{16,22} Qualitative studies are needed to better understand the relationship between race, ethnicity and PGD sharing with providers, which may vary based on experiences of discrimination in the healthcare system, medical mistrust, or other factors we are unable to capture in this study.

Limitations

This study has a number of limitations. First, the HINTS does not collect data on which medical devices (eg, blood pressure monitor, continuous glucose monitoring system) were used. Second, the HINTS does not track how patients shared the data with their healthcare provider (eg, manual upload during visit, sharing via patient portal, written record of readings). Third, the HINTS asks about a limited number of chronic conditions and therefore a Charlson Comorbidity Index cannot be calculated. We tried to overcome this limitation by calculating the number of chronic conditions as a proxy for MCCs. Fourth, the HINTS does not track sharing of PGD over time; therefore, only a cross-sectional analysis could be performed. Prior studies suggest that some patients may discontinue wearable devices after initial use (within 6 months).⁴² Further studies are needed to track longitudinal use of device adoption and sharing PGD and to test what strategies contribute to sustained use (eg, use of behavioral economics principles).³⁰ Finally, the HINTS included a small proportion (n < 10) of Spanish speakers, preventing us from comparing patterns across Spanish and non-Spanish speakers. Therefore, the results may not be representative of this population. Future studies should examine wearable device adoption and data sharing with providers among Spanish speakers.

CONCLUSIONS

As of 2019, wearable device adoption and PGD sharing with healthcare providers may be more common than prior studies have

reported. Our findings suggest that certain patients, such as patients with more income and access to a usual source of care, may have better access to wearable devices and providers who use PGD as a part of patient care. Given prior data on the impact of sharing PGD (eg, improved patient outcomes and reduced healthcare costs), future studies are needed that test implementation strategies to expand use of PGD sharing into clinical care delivery.

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AUTHOR CONTRIBUTIONS

KT developed the research question and study design, conducted the statistical analyses, and drafted the manuscript. AJ reviewed the statistical analyses and the manuscript draft and provided feedback. GW assisted with the literature review and reviewed the manuscript draft and provided feedback. AAT reviewed the statistical analyses and the manuscript draft and provided feedback. AC reviewed the statistical analyses and the manuscript draft and provided feedback. HJ helped refine aspects of the study design and methodology, reviewed the manuscript draft and provided feedback.

CONFLICT OF INTEREST

Dr. Jim has consulted for RedHill BioPharma, Janssen Scientific Affairs, and Merck.

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