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Download Alert: Understanding Gastroenterology Patients' Perspectives on Health-Related Smartphone Apps

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OBJECTIVES: The aims of this study were to understand patients' willingness to use different types of health-related smartphone apps and to explore their attitudes on the overall value, usability, feasibility, credibility, intrusiveness, and obtrusiveness of these apps. METHODS: Questionnaires were distributed to adult patients presenting to gastroenterology clinics at an academic medical center. The 25-question survey consisted of 5-point Likert-type scale statements, multiple-choice questions, and open-ended questions. RESULTS: Participants were mainly White ($N = 94$, 78%) and smartphone owners ($N = 125$, 93%). The mean age was 40.8 years ($N = 121$, s.d. = 13.2). Participants were willing to use most types of apps unless it monitored their location or social networking activity. Half were less willing to use an app if it required a visible accessory. Most participants were willing to use a health-related app up to 5 min a day indefinitely but unwilling to pay out-of-pocket for it. Participants generally disagreed that an app would be hard to learn how to use, interfere with their daily routine, or be embarrassing to use in public. Overall, participants felt that health-related apps could help them and their doctors better manage their medical problems, but were neutral in trusting their quality. Most worried that personal information used for an app would fall into the wrong hands.
CONCLUSION: Gastroenterology patients were willing to use and valued most types of health-related apps. They perceived this technology as feasible, usable, and relatively unobtrusive unless a visible accessory was required. However, many were concerned about their privacy.

INTRODUCTION

Nearly 70% of adults in the United States track at least one aspect of their health and more than 20% currently use some form of electronic technology to do so.[1] There are already over 40,000 health-related apps available to supply this growing demand, based on a study from Juniper Research, a British company that studies trends in mobile technology.[2] By 2015, it is estimated that over 500 million people worldwide will be using a health-related app.[3]

Consumers are not the only ones seeking electronic health (eHealth) technologies, so are patients, including gastroenterological (GI) ones.[4,5] Adults with one or more chronic condition(s) are more likely to track health indicator(s) compared with healthy consumers, making them the largest market for health-related apps.[1,6] Popular GI-focused apps include GI Monitor, GI Buddy, and Colonoscopy Prep Assistant. Over 500,000 people have installed GI Monitor from WellApps (Medivo, Inc, New York, NY) onto their smartphones. On Facebook, the largest social networking site in the world, there are currently 25 groups for inflammatory bowel disease (IBD) alone, with over 24,000 followers in the largest of them.[5]

Health-related apps are becoming increasingly ubiquitous in our patients' lives, yet little is known about patients' perspectives of them. The few studies exploring patients' attitudes on eHealth technologies, such as mobile phone remote monitoring and text messaging, are primarily limited to focus groups and do not center on GI patients.[7–9] They are also relatively outdated given how much the role of smartphones has changed in our society since Apple's first iPhone was released in 2007.[10]

Understanding patients' attitudes on health-related apps can provide insight on how to create more meaningful health-related apps that patients will actually use. Ninety percent of all downloaded apps are used only once and eventually deleted by users.[11] This low level of adherence for health-related apps is largely attributed to the lack of any patient input in its development. Although there are exceptions such as Crohnology, a patient-powered research network designed by a Crohn's patient, most health-related apps have largely evolved from consumer demand, designed without a targeted medical condition in mind, and created primarily by software engineers. Knowing what patients expect from health-related apps can improve its clinical effectiveness in addition to patient satisfaction and compliance.[12]

Gaining patients' perspectives on health-related apps is also important for healthcare providers. Eighty-four percent of IBD patients wished that their providers knew how to direct

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them to something as simple as a trustworthy website and these conversations are now expanding to health-related apps.[5] Although the extent is not clear, patients perceive recommendations given by their health providers as more credible.[13] Providers, however, are not yet prepared for these conversations. Critical reviews of health-related apps in the medical literature are essentially non-existent, as there are no governing bodies requiring these apps to be validated for clinical effectiveness at this time. Most providers are therefore unfamiliar with currently available health-related apps. There is also a lack of integration of these apps into healthcare systems, although this is changing.[14,15] Partnerships between consumer device manufacturers and healthcare systems are forming such as iOS's Healthkit, where Apple (Cupertino, CA) has collaborated with the Mayo Clinic (Rochester, MN) and eHealth record vendor, Epic (Verona, WI). Provider-driven apps are also being developed for specific patient populations such as Mayo Clinic's Mayo myCare and Cincinnati Children's IBD 2.0. Most importantly though, providers lack an understanding on what patients seek to gain from a health-related app and what facilitates or inhibits their use of these apps. The perceived benefits of health-related apps can potentially highlight the void not being fulfilled by current clinical practices.

The primary aim of this study is to better understand GI patients' willingness to use different types of health-related apps and to explore their current attitudes on the overall value, usability, feasibility, credibility, intrusiveness, and obtrusiveness of these apps. Through open-ended responses, we also explore the perceived benefits and concerns patients have regarding the use of health-related apps during the present times. A secondary aim is to look at differences in patients' attitudes on health-related apps based on demographics and underlying GI conditions.

METHODS

This was a cross-sectional questionnaire survey of adults presenting to gastroenterology clinics associated with an academic center (University of Washington Medical Center, Seattle, WA; University of Washington Eastside Specialty Center, Bellevue, WA). Over a 3-month period, all English-speaking patients over the age of 18 years checking in for a gastroenterology procedure or clinic appointment were recruited to participate in this study. The first page of the questionnaire explained the objectives and the voluntary and anonymous nature of our study. Participants completed the questionnaire either immediately in the waiting/clinic rooms or later at home. Human subjects institutional review approval was obtained before recruitment (February 2014).

Questionnaire design. In the absence of a standardized instrument, two authors (J.Z. and G.D.) developed a 25-question survey to better understand patients' willingness to use different types of health-related smartphone apps and to explore their attitudes on the overall value, usability, feasibility, credibility, intrusiveness, and obtrusiveness of these apps. The questionnaire was based on an existing theoretical framework of "Obtrusiveness of Telehealth Technologies".[16] This framework broadly defines obtrusiveness as "a summary evaluation by the user based on characteristics

or effects associated with the technology that are perceived as undesirable and physically and/or psychologically prominent". This definition includes eight underlying dimensions of obtrusiveness (physical, usability, privacy, function, human interaction, self-concept, routine, and sustainability) that we used to develop specific items for our survey. A panel of experts in the field of questionnaire design reviewed the survey draft for face validity and provided feedback for edits and modifications. Five healthy pilot participants from the community then completed the revised survey and provided feedback on the structure and their comprehension of the questionnaire, which contributed to the final edits of the survey.

The survey had participants agree or disagree to statements using a 5-point Likert-type scale, select responses to multiple-choice questions, and answer open-ended responses. It took ~15 min to complete. Demographic information on age, gender, race/ethnicity, education, marital status, and ownership and experience with smartphones were also asked. Participants were also asked to select the GI condition(s) and/or symptom(s) on why they were visiting the doctor; more than one response could be selected by a participant.

Data analysis. The data were entered into an ACCESS 97 database (Microsoft, Redmond, WA) by T.L. for storage. All statistical analyses were conducted using the R Statistical Software v2.15.2.[17] Kruskal–Wallis or Mann–Whitney U-tests were conducted to examine the relationship between all other socioeconomic demographic variables (gender, race, education, marital status, prior health-related app experience, smartphone ownership, and underlying gastrointestinal condition) and questionnaire responses. *Post-hoc* one-sided pairwise Mann–Whitney U-tests were conducted with a Bonferroni correction, to account for multiple comparisons if earlier comparisons indicated statistical significance.

For the free-response questions, qualitative analyses were performed as follows. For the question asking participants to list specific examples of health-related apps, a tally was performed for each individual app and later each app was categorized into their offered functions such as meal tracking, exercise tracking, exercise routines, meal planning, and/or symptom tracking. An individual app could be categorized into one or more functions.

For written responses on the benefits and concerns experienced and/or anticipated from using health-related apps, emerging generalized themes were identified to reflect participants' attitudes by J.Z. Each written response was categorized into these general theme(s) by a manual indexing system by J.Z. G.D. and T.L. confirmed the emerging themes and the categorization of each written response. Any disagreements on the themes and/or categorization were resolved by a discussion between J.Z., G.D, and T.L.

RESULTS

Over a 3-month period, 135 questionnaires were returned where 71 (52%) were completely filled out. All participants ($n = 135$, 100%) responded to the survey's questions regarding smartphone ownership and health-related app experience.

Of the 85 (62%) participants who endorsed the use of a prior health-related app, half ($n=44$, 52%) provided specific app examples. Almost all participants ($n=130$, 96%) completed the 5-point Likert-scale questions, whereas only 84 (62%) provided written responses to the open-ended questions.

Participant baseline demographics and clinical characteristics. The baseline demographic and clinical characteristics of participants are given in Table 1. Participants were mostly middle-aged, White, and owned a smartphone.

Responses to 5-point Likert-scale statements. Participants' responses to the 5-point Likert-scale statements, categorized by intended themes, are shown in Table 2. The majority of participants were willing to use all listed types of health-related apps unless it continuously monitored their location or social networking. If a health-related app required the use of a visible accessory, most participants were also less willing to use that app (52%). The majority of participants agreed that health-related apps could help them (51%) and their doctor better manage their medical problems (66%). Participants mostly disagreed that a health-related app would be hard to learn how to use (73%) or would significantly interfere with their daily routines (62%). The majority of participants were "afraid" that personal information used for a health-related app would get into the "wrong hands" (64%).

The majority of participants were willing to use an app for their health problems up to 5 min a day (58%) indefinitely (61%) but were unwilling to pay out-of-pocket for it (39%). Figure 1 displays the distribution of what participants were willing to pay and the maximum time they were willing to commit both daily and long-term for a beneficial health-related app.

Questionnaire responses based on demographics and gi condition(s). Table 3 summarizes questionnaire response differences based on baseline demographics and presenting GI conditions. White participants were willing to pay higher amounts and commit to longer daily times to enter information into an app compared with non-Whites. Single participants were less willing to use apps to receive therapies than married/partnered participants. There was no significant difference in questionnaire responses based on age, gender, or education. Participants with prior experience using a health-related app were overall more willing to use the following types of health-related apps compared with their counterparts: to track lifestyle habits, for medical information, to monitor health, and to receive therapies. They were more likely to agree that information from an app could help their doctor better manage their medical problems and less likely to worry that an app would be hard to use. They were also willing to use health-related apps for longer periods of time compared with their inexperienced counterparts.

Participants with irritable bowel syndrome (IBS) were more willing than non-IBS participants to use an app for tracking bowel symptoms, continuously monitoring their location, and receiving therapies. They were also more willing to use an app to receive personal feedback, as were participants experiencing constipation. IBS participants however were more likely to agree that using such apps in public may be embarrassing.

Table 1 Baseline demographics and clinical characteristics

Variable		Respondents (N)
Baseline demographics		
Age, mean (s.d.)	41 (13)	121
Sex, female (n, %)	73 (60%)	122
Race, Caucasian (n, %)	94 (78%)	120
Married/partnered	65 (54%)	121
College educated or above	67 (56%)	120
Smartphone ownership	125 (93%)	135
Prior health-related app use	85 (65%)	135

Variable		Respondents ($N=119$)[a]
Clinical characteristics		
Inflammatory bowel disease	53 (45%)	
Abdominal pain/bloating	29 (24%)	
Irritable bowel syndrome	23 (19%)	
Diarrhea	23 (19%)	
Heartburn	21 (18%)	
Constipation	20 (15%)	
Stomach upset/ulcers	16 (13%)	
Bloody stools	10 (8%)	
Other	40 (34%)	

[a]Respondents could select more than one response regarding which gastrointestinal condition(s) they had or which symptom(s) they were experiencing.

Participants with diarrhea were more likely to agree that use of an app would significantly interfere with their daily routine compared with non-diarrhea participants. Lastly, IBD patients were more afraid that their personal information would get into the "wrong hands" when using an app, yet willing to use these apps for longer periods of time than non-IBD participants.

Open-ended responses. Participants reported using 29 different health-related apps. The most frequent ones were MyFitnessPal ($n=6$) and Weight Watchers ($n=4$), both geared toward weight loss/general health. Participants most often used apps to track meals ($n=20$, 45%), track exercise ($n=20$, 45%), record and support weight loss ($n=19$, 43%), generate exercise routines ($n=12$, 27%), learn more about medical conditions ($n=9$, 20%), and track bowel symptoms ($n=8$, 18%).

The themes that emerged when participants were asked about the benefits and concerns experienced and/or anticipated from using health-related apps are displayed in Table 4. Themes are supported with representative quotes.

DISCUSSION

Gastroenterology patients were willing to use most types of health-related apps. They perceived this technology as valuable, feasible, usable, and relatively unobtrusive unless a visible accessory such as a wristwatch was required. Although the perceived credibility of health-related apps increased if recommended by a doctor, most patients distrusted the current quality of health-related apps and were concerned about their privacy. Differences in questionnaire responses were observed for race, marital status, smartphone ownership, prior health-related app experience, and certain underlying GI conditions, but not for age, gender, or education.

Table 2 Responses to 5-point Likert-scale statements categorized by intended themes
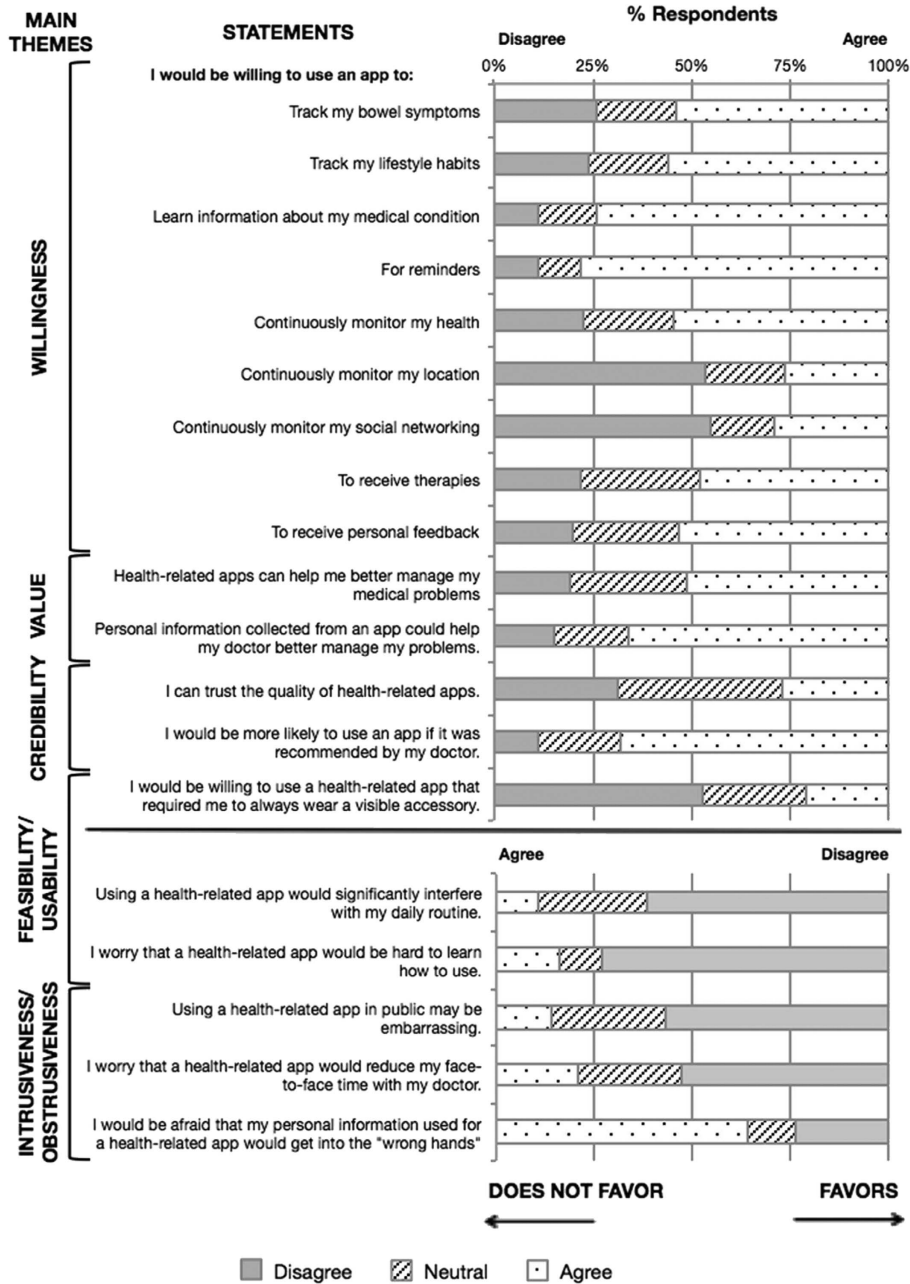
Total number of respondents was 130 (96%).
If participants circled 1 to 2 on the 5-point Likert scale, their response was considered "Disagree." If they circled 3, their response was considered "Neutral." If they circled 4 or 5, their response was considered "Agree."
The horizontal bolded black line notes the change in direction of statements in or not in favor of health-related smartphone apps.

The most common emerging themes on the benefits and concerns of health-related apps from open-ended responses were self-awareness from tracking and personal security, respectively.

The willingness to use most types of health-related apps was not surprising given the rising number of available health-related apps and people owning smartphones.[1,2,18] This high degree of eHealth acceptance has been previously observed in other patient populations.[7–9] The only exceptions to this willingness were for apps that allowed continuous monitoring of one's location and social networking. These types of apps are considered more obtrusive to one's privacy. They can potentially expose personal, and even embarrassing, behaviors. Even when patients do not consider some of their health
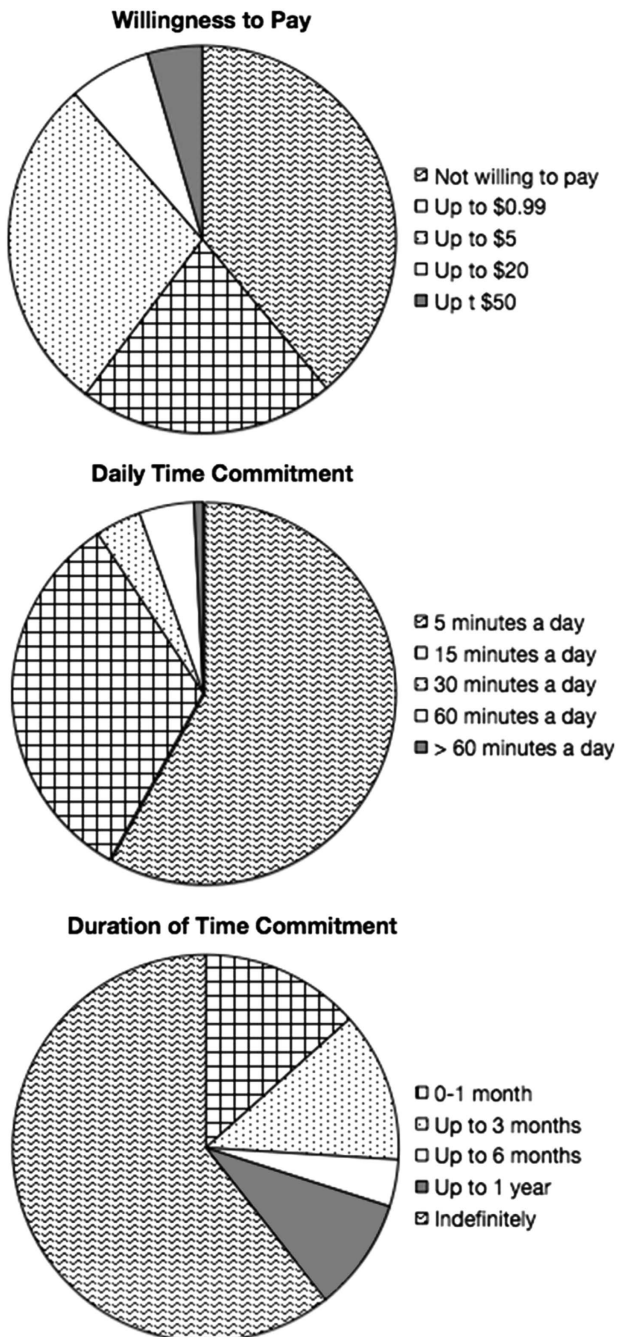
Willingness to Pay

- ☑ Not willing to pay
- ☐ Up to $0.99
- ☐ Up to $5
- ☐ Up to $20
- ☑ Up t $50

Daily Time Commitment

- ☑ 5 minutes a day
- ☐ 15 minutes a day
- ☐ 30 minutes a day
- ☐ 60 minutes a day
- ☑ > 60 minutes a day

Duration of Time Commitment

- ☐ 0-1 month
- ☐ Up to 3 months
- ☐ Up to 6 months
- ☑ Up to 1 year
- ☑ Indefinitely

Figure 1 Participants' willingness to pay and time commitment thresholds for daily and long-term use.

data private or risky to share, they can still perceive it as inappropriate to share.[19] However, not a single participant explicitly expressed any "Big Brother" fear of being under constant surveillance in the open-ended responses.

Participants might have been more willing to use apps monitoring their location and social networking if more of an explanation was provided. Although privacy is considered an important right, attitudes to what is and what is not private data vary between people in different contexts and roles.[20] For example, participants might have been more receptive to

using an app if it only used location monitoring to help find the nearest restroom such as the Charmin SitOrSquat app (Proctor & Gamble, Cincinnati, OH). Patients might also be more willing to accept obtrusive technology if its health benefits outweigh potential risks.

Most participants were less likely to use an app if it required wearing a visible accessory such as a wristwatch. This was an unexpected finding, as there has clearly been a growing market for commercially available wearable sensors such as FitBit and Nike+ FuelBand.[21] This unwillingness appeared to be uniform among all demographic factors and GI conditions. Healthy consumers might be more receptive than adults with chronic conditions in wearing a visible accessory where a potential stigma could be associated with it.

We were also surprised that the perceived usability and feasibility of health-related apps did not vary with age. Advancements in technologies were previously thought to divide the aged and young in its use due to access and familiarity issues.[22] This gap however appears to be narrowing over time. Rates of smartphone and tablet ownership have been increasing over the past years for seniors (adults over age 65).[18] Technological advancements are also being specifically developed for the older population. For example, the Mayo Clinic developed an interactive iPad program called "Mayo myCare" to educate and provide treatment plans for post-operative adult cardiac surgical patients. Over 80% of the study participants ($N = 149$) used and felt very comfortable using this program.[23,24]

Attitudes varied based on a participants' underlying GI condition. How an underlying medical condition affects one's life and encounters with the medical system could possibly account for these differences. For example, IBD patients have a chronic medical condition that requires regular check-ups, medications, and lab tests. As a result, they might be willing to invest more time in their care to prevent a hospitalization, such as long-time use of a health-related app. Patients with IBS, on the other hand, frequently suffer from concurrent psychological comorbidities such as anxiety or depression.[25] These overlapping diagnoses might explain why IBS participants were more likely to find using an app in public to be embarrassing.

Increased self-awareness from tracking was the most anticipated benefit of health-related apps by our participants. This benefit has been demonstrated in prior eHealth studies and, as a result, led to improvements in both adherence (medications and/or behavior) and health endpoints. For example, a study by Katz et al.[26] delivered daily text messages to Type II diabetic patients summarizing his/her 7- and 14-day blood glucose averages. After 3 months of use, the authors observed increased diabetic self-care activities and significant reductions in glycosylated hemoglobin levels. Similar health benefit effects were achieved for hypertensive and heart failure patients.[7,27]

Many participants also felt that self-tracking empowered them to actively participate in their health. Prior studies have demonstrated the clinical efficacy of self-management programs for arthritis, diabetes, and IBS patients, which emphasized individual responsibility in illness management.[28,29] Health-related apps could be a key tool in engaging people with their healthcare.

Table 3 Summary comparison of questionnaire items across each demographic item and clinical characteristics

Demographic variable

Race	P value	N	≤ 5 min	≤ 15 min	≤ 30 min	≤ 60 min	> 60 min
Maximum time entering app *data*	< 0.05						
White/Caucasian		82	43 (52%)	34 (41%)	5 (6%)	0 (0%)	1 (1%)
Non-White		24	18 (78%)	5 (22%)	0 (0%)	0 (0%)	0 (0%)
	P value	N	Not willing	≥ $0.99	≥ $5	≥ $20	≥ $50
Amount willing to pay	< 0.01						
White/Caucasian		115	35 (30%)	28 (24%)	37 (32%)	9 (8%)	6 (5%)
Non-White		26	16 (62%)	3 (12%)	7 (27%)	0 (0%)	0 (0%)
Marital status	P value	N	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Willing to use an app to receive therapies	< 0.05						
Single/never married		42	5 (12%)	9 (21%)	16 (38%)	5 (12%)	7 (17%)
Married/partnered		78	6 (8%)	5 (6%)	20 (26%)	28 (36%)	19 (24%)
Prior use of health-related app	P value	N	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Willing to use an app to track lifestyle habits	< 0.001						
Prior experience		49	1 (2%)	3 (6%)	9 (18%)	17 (35%)	19 (39%)
No experience		83	16 (19%)	12 (14%)	18 (22%)	15 (18%)	22 (27%)
Willing to use an app for medical information	< 0.05						
Prior experience		50	0 (0%)	2 (4%)	6 (12%)	12 (24%)	30 (60%)
No experience		84	10 (12%)	3 (4%)	14 (17%)	17 (20%)	40 (48%)
Willing to use an app to monitor health	< 0.01						
Prior experience		50	1 (2%)	6 (12%)	8 (16%)	16 (32%)	19 (38%)
No experience		83	9 (11%)	14 (17%)	22 (27%)	15 (18%)	23 (28%)
Willing to use an app to receive therapies	< 0.05						
Prior experience		50	2 (4%)	4 (8%)	15 (30%)	16 (32%)	13 (26%)
No experience		84	13 (15%)	11 (13%)	25 (30%)	20 (24%)	15 (18%)
Apps help me manage my medical problems	< 0.01						
Prior experience		47	1 (2%)	0 (0%)	16 (34%)	18 (38%)	12 (26%)
No experience		81	7 (9%)	15 (19%)	23 (28%)	24 (30%)	12 (15%)
Information collected from an app can help my doctor better manage my problems	< 0.05						
Prior experience		49	1 (2%)	0 (0%)	6 (12%)	12 (24%)	30 (60%)
No experience		80	10 (12%)	3 (4%)	14 (17%)	17 (20%)	40 (48%)
Worry that app would be hard to learn how to use	< 0.01						
Prior experience		49	31 (63%)	11 (22%)	4 (8%)	1 (2%)	2 (4%)
No experience		80	34 (43%)	17 (21%)	11 (14%)	9 (11%)	9 (11%)
		N	0–1 Month	≥ 3 Months	≥ 6 Months	≥ 1 Year	Indefinite
Maximum time period using *app*	< 0.001						
Prior experience		50	2 (4%)	4 (8%)	1 (2%)	4 (8%)	39 (78%)
No experience		77	15 (19%)	12 (16%)	4 (5%)	8 (10%)	38 (49%)

Gastrointestinal condition

Inflammatory bowel disease	P value	N	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Afraid information used for app would get into the "wrong hands"	< 0.05						
IBD		53	7 (13%)	7 (13%)	10 (19%)	19 (36%)	10 (19%)
No IBD		77	9 (12%)	8 (10%)	6 (8%)	23 (30%)	31 (40%)
	P value	N	0–1 Month	≥ 3 Months	≥ 6 Months	≥ 1 Year	Indefinite
Maximum time period using app	< 0.01						
IBD		51	2 (4%)	5 (10%)	3 (6%)	3 (6%)	38 (75%)
No IBD		76	15 (18%)	11 (15%)	2 (3%)	9 (12%)	39 (51%)
Irritable bowel syndrome							
	P value	N	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Willing to use an app to track bowel symptoms	< 0.05						
IBS		23	1 (4%)	0 (0%)	5 (22%)	7 (30%)	10 (43%)
No IBS		110	22 (20%)	11 (10%)	22 (20%)	21 (19%)	34 (31%)
Willing to use an app to continuously monitor my location	< 0.05						
IBS		23	3 (13%)	4 (17%)	8 (35%)	4 (17%)	4 (17%)
No IBS		110	38 (35%)	26 (24%)	19 (17%)	12 (11%)	15 (14%)
Willing to use an app to receive therapies	< 0.05						
IBS		23	2 (9%)	1 (4%)	4 (17%)	8 (35%)	8 (35%)
No IBS		111	13 (12%)	14 (13%)	36 (32%)	28 (25%)	20 (18%)

Table 3 (*Continued*)

Gastrointestinal condition							
Willing to use an app to receive personal feedback	<0.001						
IBS		23	1 (4%)	0 (0%)	2 (9%)	9 (39%)	11 (48%)
No IBS		110	15 (14%)	10 (9%)	34 (31%)	25 (23%)	26 (23%)
More likely to use an app if recommended by my doctor	<0.01						
IBS		23	0 (0%)	1 (4%)	2 (9%)	8 (35%)	12 (52%)
No IBS		108	7 (6%)	6 (6%)	26 (24%)	39 (36%)	39 (28%)
Using an app in public may be embarrassing	<0.01						
IBS		23	3 (13%)	4 (17%)	12 (52%)	1 (4%)	3 (13%)
No IBS		107	36 (34%)	31 (29%)	26 (24%)	11 (10%)	3 (3%)
Diarrhea							
	P value	*N*	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Using an app would significantly interfere with my daily routine	<0.01						
Diarrhea		23	3 (13%)	6 (26%)	7 (30%)	6 (27%)	1 (4%)
No diarrhea		107	27 (25%)	44 (41%)	29 (27%)	5 (5%)	2 (2%)
Acid Reflux/Heartburn							
	P value	*N*	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
More likely to use an app if recommended by my doctor	<0.05						
Heartburn		21	1 (5%)	2 (10%)	1 (5%)	5 (24%)	12 (57%)
No heartburn		110	6 (5%)	5 (5%)	27 (25%)	42 (38%)	42 (27%)
Constipation							
	P value	*N*	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Willing to use an app to receive personal feedback	<0.01						
Constipation		19	1 (5%)	2 (10%)	3 (16%)	3 (16%)	10 (53%)
No constipation		114	15 (13%)	8 (7%)	33 (29%)	31 (27%)	27 (24%)
Bloody stools							
	P value	*N*	0–1 Month	≥ 3 Months	≥ 6 Months	≥ 1 year	Indefinite
Maximum time period using app	<0.05						
Bloody stools		9	0 (0%)	0 (0%)	1 (11%)	1 (11%)	7 (78%)
No bloody stools		118	17 (14%)	16 (14%)	4 (3%)	11 (9%)	70 (59%)

IBD, inflammatory bowel disease; IBS, irritable bowel syndrome.
Only conditions with statistically significant differences are shown.
Kruskal–Wallis or Mann–Whitney tests were conducted to identify relationship between socioeconomic demographic variables and questionnaire response. When appropriate, *post-hoc* one-sided pairwise Mann–Whitney tests were conducted with a Bonferroni correction.

Another anticipated benefit of health-related apps by participants was improved provider communication and access. Electronic messaging has previously shown improved patients' satisfactions with doctor–patient communication.[30–33] Prior provider focus groups also reported the benefits of such a system such as an avoidance of telephone tag, a lower threshold for patients to initiate communication, and an overall improved sense of patient engagement, satisfaction, and trust.[32–34]

Participants in the study also stressed how helpful app reminders would be in relaying their symptoms to their providers and for adherence to medications, appointments, and labs. Text-message reminders have indeed shown such improvements in adherence for on-time vaccinations, medications, and behavioral modifications for smoking cessation and weight loss.[35–39] As a data collection tool, electronic mobile diaries have resulted in improved patient compliance rates and higher quality entries compared with paper diaries.[40–42]

Surprisingly, only one participant remarked that using a health-related app could "provide (some) peace of mind." We expected more of our participants to feel reassured that their providers would be "watching over them" as expressed in prior patient focus groups.[7] This potential benefit might have been viewed differently by our participants, instilling a sense of "accountability" rather than "reassurance". Although our participants viewed "accountability" in a positive light, past focus groups viewed it negatively, afraid that eHealth applications would download new responsibilities on them.[43] Perhaps this highlights an attitude difference between GI patients and other studied patient populations and/or reflects the changing role of smartphones in our society.

By far the biggest concern participants voiced in this study was personal data security. With the increasing integration of social network and cloud storage features in health-related apps, this concern is anticipated to grow. Most were afraid their personal information used for a health-related app could get into the "wrong hands", which they elaborated on during their open-ended responses as insurers and advertisers. eHealth focus groups in the past were less concerned about these issues.[7] This change in patient perspectives likely stems from the increasing media exposure on security and privacy data breaches. Prominent social networking platforms and search engines are being accused of providing consumers' private, personal information to outside third parties for targeted advertising, digital social-behavior spying, and unconsented research. More recently, in February 2015, over tens of millions of customer records were stolen during a

Table 4 Most common emerging themes from open-ended questions

Benefits of health-related apps	
Self-awareness from tracking	31 (37%)
"It would prompt me to be more thoughtful about my condition."	
"Keeping track of things over time may show a clue as to what is going on."	
Convenience and efficiency	14 (17%)
"At fingertips"	
"Integrates with my life easily."	
Provides communication and access	14 (17%)
"Better information flow between me and my doctor."	
"Easier access to my doctor."	
Reminders	14 (17%)
"Recording symptoms regularly and not having to guess times and occurrences."	
"Reminders for medication times and blood work."	
Constant, immediate access	8 (10%)
"Right away information."	
"Better, faster communication with MD staff."	
Concerns of health-related apps	
Personal data security	33 (39%)
"Falls into insurer's hands or hacked by bad guys."	
"People getting my information and trying to sell me stuff."	
Burden (time, interface)	16 (19%)
"Takes too long, or is too complicated for the intended purpose."	
"Sometimes interfaces are annoying or there are a lot of extras I don't need."	
"Not interested in entering lots of info every day, no time."	
"I don't want to invest inputting data every day to get nothing more than the same kind of info I'll get when I come in and talk with my doctor."	
No concerns	18 (21%)
"None."	
"I have no concerns and think it is a great idea."	

Total number of respondents was 85 and 84, respectively, for the benefits and concerns of health-related apps.

massive cyberbreach from Anthem, the country's second largest health insurer.

Our participants' concerns of unnecessary, tedious, and unmeaningful health-related apps were echoed in prior studies. Participants in a focus group by Seto et al.[7] questioned the necessity of monitoring their symptoms daily. In a study by Bostock et al.,[8] participants felt that remote blood pressure monitoring using mobile phones was suitable only to those with newly diagnosed or uncontrolled hypertension. Designers of future apps should focus on minimizing unnecessary user burden by implementing different user interfaces and/or requirements depending on a patient's disease onset, control of the disease, and/or severity of disease.

Six participants (7%) in our study voiced concerns about a loss of face-to-face time with their doctor as a result of using health-related apps. Prior eHealth studies have demonstrated conflicting perspectives over this concern. When electronic messaging systems were introduced at large health organizations (Group Health Cooperative in Seattle and Kaiser Permanente in Hawaii), in-person outpatient visits did drop with a concurrent increase in virtual encounters (electronic mail and telephone).[44,45] The trade-offs between in-person contact with providers and the time saved from trips to the hospital varied for each individual.[43] Some patients reported no preference on how they interacted with their provider (phone, electronic mail, or in-person) as long as they were "heard by a provider who was taking time to respectfully listen".[43]

The results of this study provide novel and current insight into GI patients' attitudes on health-related apps. It is our hope that these results will provide guidance to the development of future health-related apps and/or other clinical tools for GI patients. As medicine transitions to a "patient-centered care" model, placing the patient at the center of care, more research needs to focus on understanding patients' perspectives of their care. After all, how can we design a clinically effective and meaningful patient tool without first understanding what patients expect from it?

Study limitations. This study was conducted in one of America's most wired city, Seattle, WA.[46] In this study, 93% of participants owned a smartphone app compared with the national average of 55%.[18] Patient recruitment for this study was also limited to two GI practices associated with a single academic center. The overall favoring of health-related apps in this study might not therefore accurately reflect GI patients' perspectives for the entire nation.

This study also restricted its participation to English-speaking people and, as a result, the majority of participants were Caucasians. There was also likely an inherent bias on who chose to respond to our questionnaire; patients without a smartphone might have been less inclined to participate, further inflating the percentage of smartphone owners in our study.

Another limitation of our study was our questionnaire instrument. It was developed for this study and thus has not been extensively tested for reliability and validity. We did

however use a validated theoretical framework to inform its design and addressed some aspects of face validity via expert and pilot participant reviews.

There were possible overlapping GI diagnoses, especially as participants could select more than one GI condition. For example, a patient might have selected both "IBS" and "diarrhea" when his/her true diagnosis could have been summarized as only "IBS". A misdiagnosis might have also occurred given that responses were not verified with the medical chart and participants typically filled out the survey before visiting the provider. For example, a participant may have checked off "bloody stools" when his/her actual diagnosis was "IBD." Both of these scenarios might have affected the relationship observed between GI conditions and questionnaire responses.

Finally, despite our intention of providing up-to-date patient perspectives on health-related apps, the findings of this article will quickly become obsolete. Not only is smartphone ownership continuing to rise steadily in all age groups, so are the number of available apps. In 2013, smartphone apps increased by 115%.[18,47] According to Flurry Insights, the fastest growing app category over the next few years will be health and fitness.[48] The rapid technological development, advancement, and adoption with wearable sensors are likely contributing to the growth of health-related apps.

Future studies. Future studies should increase the sample size of this study to include GI patients not only from different regions of the country but also from different types of GI practices (academic, community, and private). We should also examine and compare the perspectives of other patient and even non-patient populations on health-related apps. As the growth and familiarity of custom apps for specific medical conditions increases, future studies should update patients' views on health-related apps. More in-depth understanding on specific questionnaire responses should also be conducted via patient focus groups and interviews. For example, given the prevalent concern of obtrusiveness in this study, participants should be interviewed on which information they would be willing to share and with whom, given a variety of scenarios. Future questionnaires, interviews, and focus groups should also be conducted with healthcare providers to better understand their views on health-related app for improved integration of these tools into clinical workflows.

CONFLICT OF INTEREST

Study Highlights

WHAT IS CURRENT KNOWLEDGE

✓ 58% Of American adults own a smartphone.

✓ 70% Of US adults track at least one aspect of their health.

✓ GI patients' views on health-related apps are largely unknown.

WHAT IS NEW HERE

✓ GI patients are willing to use most health-related apps unless it monitors their location or social networking.

✓ GI patients perceived this technology as feasible, usable, and relatively unobtrusive.

✓ They are most concerned about personal data security and time consumption with the use of health-related apps.

✓ The average patient is willing to use a health-related app up to 5 min a day indefinitely but is unwilling to pay out-of-pocket for it.

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