<u>Original Paper</u>

Adolescents' Perspectives on Using Technology for Health: Qualitative Study

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Abstract

Background: Adolescents' wide use of technology opens up opportunities to integrate technology into health visits and health care. In particular, technology has the potential to influence adolescent behavior change by offering new avenues for provider communication and support for healthy choices through many different platforms. However, little information exists to guide the integration of technology into adolescent health care, especially adolescents' perspectives and preferences for what they find useful.

Objective: This qualitative study aimed to take a broad approach to understanding adolescents' use of technology for supporting their overall health and to understand whether and how adolescents envision using technology to enhance their health and clinical care, particularly in communicating with their provider.

Methods: Adolescents (13-18 years) were recruited to participate in semi-structured, in-depth individual interviews. Potential participants were approached in-person through the Seattle Children's Hospital Adolescent Medicine Clinic while they were waiting for consultation appointments, through outreach to youth who expressed interest in other local research study activities, and via flyers in waiting rooms. Interviews were recorded, transcribed, and analyzed using a thematic analysis approach.

Results: Thirty-one adolescents (58% female, mean age 15.2 years) were interviewed and described 3 main uses of technology: (1) to gather information, (2a) to share their own experiences and (2b) view others' experiences in order to gain social support or inspiration, and (3) to track behaviors and health goals. Perceived benefits and potential downsides were identified for technology use. Teens desired to use technology with their provider for 3 main reasons: (1) have questions answered outside of visits, (2) have greater access to providers as a way to build relationship/rapport, and (3) share data regarding behaviors in between visits. Social media was not a preferred method for communicating with providers for any of the youth due to concerns about privacy and intrusiveness.

Conclusions: Although youth are avid users of technology in general, in regard to technology for health, they display specific use preferences especially in how they wish to use it to communicate with their primary care provider. Health care providers should offer guidance to youth with regard to how they have used and plan to use technology and how to balance potential positives and negatives of use. Technology developers should take youth preferences into account when designing new health technology and incorporate ways they can use it to communicate with their health care provider.

(JMIR Pediatr Parent 2018;1(1):e2) doi: 10.2196/pediatrics.8677

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KEYWORDS

adolescent; adolescent health services, technology; primary health care, social media; qualitative research

Introduction

Adolescents are avid users of new technologies, with a quarter of adolescents online almost constantly and almost all (92%) online daily [1]. Most teens (84%) have used the internet to search health topics online, 21% have downloaded mobile apps, 12% have played a health-related game, and 7% have worn a wearable health device [2]. Across health topics, teens express a desire for online, accessible information and health interventions which are technology-based as opposed to in person, telephone, or paper.[3] When health websites and text messaging services are made available to teens, they are highly utilized [4-7]. Due to adolescents' frequent use and openness to trying out new technology tools, the trend for technologies directed at health improvement may have an important influence on adolescent health.

Much of the research eliciting adolescents' preferences for incorporating technology in health care has examined the use of patient electronic portals with respect to confidentiality and its influence on adolescent utilization of technology. A systematic review examining pediatric use of patient portals found that in general account activation is low for teens due to barriers such as concerns about confidentiality [8,9]. However, one additional study found when confidentiality was ensured by a patient portal, adolescents used them as frequently as parents of younger children [10]. Other studies have been conducted to quantify what types of technologies adolescents prefer. When considering communication with their provider, one study found adolescents preferred email or text over video communication [3], another found adolescents preferred emails to follow-up after visits over texts [11], and a third found texts were preferred over using social media [12]. While almost all adolescents surveyed in the latter study used social media, only 25% felt social media could give them useful health information [12]. While these studies are useful in summarizing overall adolescent preferences, little attention has been given to what drives adolescents' preferences for technology use and how they use various technological media for their health [13].

Adolescents' predilection for technology suggests they will adopt technology integrated into health visits and health care. As most adolescent health care is centered around prevention efforts, prioritizing use and design of interventions which incorporate technology into behavior change interventions, such as for healthy eating, incorporating exercise, or improving sleep quality may be beneficial. Providers may be able to offer further resources, intervene earlier, and troubleshoot problems in the moment as patients are implementing behavior change more readily using technology than through traditional phone calls and office visits. However, adolescents' perspectives and preferences for what they find useful are needed to guide the integration of technology into adolescent health care. This qualitative study aimed to elicit adolescents' perspectives on how they currently use technology to support their health and to gain insights into what factors may influence their future use

of technology to improve their health or communication with their provider. Gathering more in-depth qualitative information on these topics may be useful in informing clinicians how to use technology to engage with their patients and in providing insights into adolescent preferences for people who design new technology tools for health.

Methods

Recruitment and Participants

A total of 31 adolescents (18 females and 13 males) participated in in-depth semi-structured interviews in Seattle, WA. Potential participants were approached in-person at the Seattle Children's Hospital Adolescent Medicine Clinic while they were waiting for consultation appointments, through outreach to youth who expressed interest in other local research study activities, and through posted flyers in the waiting rooms of the adolescent and sports medicine clinics. Of the 31 participants, 26 were recruited from the waiting room of the adolescent clinic, 5 were recruited from community sources, and 1 was recruited via flyer. Purposive sampling methods were used to ensure the sample included nearly balanced numbers of genders (male and female) and age ranges (13-15 and 16-18 years) as well as adolescents representative of racial and ethnic diversity of the Seattle area.

Adolescents were eligible to participate if they were between the ages of 13 and 18 and could read and speak English. Consent or assent was obtained from adolescents who were interested and eligible. Parental permission was required for participants under 18. As described in the consent and assent forms, the youths' responses were kept confidential except in cases where the youths indicated that they were planning to hurt themselves or someone else. Approval was obtained for all study procedures from the Seattle Children's Hospital Institutional Review Board.

Procedures

Prior to being interviewed, adolescent participants privately completed a tablet-based electronic health assessment called Check Yourself, that covered health behaviors including exercise, nutrition, sleep, safety, sexual activity, depression, and alcohol and drug use [12]. The health assessment provided direct feedback to the adolescents on their health behaviors, including how they compared to recommended guidelines for their age. Following completion of the health assessment, adolescents participated in individual interviews lasting approximately 45-60 minutes. Three study team members—2 female (KK and one other) and 1 male—trained in qualitative interview techniques conducted the interviews. The interviewers did not know the respondents prior to the time of the interview. Only 1 interviewer had medical training as a physician and worked in the adolescent medicine clinic where recruitment took place, however, she was not involved in recruitment and did not conduct interviews with any of her patients. Interviews were conducted between February and July, 2015 and took place primarily in a private room in the same building as the adolescent clinic used for recruitment.

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Textbox 1. Questions from qualitative interview guide regarding technology in adolescent health.

- *Have you tried any types of technology, like smartphone or tablet apps or social media, to help you with your health? Tell me about how you used it. What did you like or not like about them?*

- *What role do you think technology (like smartphone and tablet apps and social media) can play in keeping teens healthy?*

- *What technologies would you be most likely to use to communicate with your provider?*

- *What would make you want to use one form of communication over another?*

When scheduling constraints prevented the interview from occurring at the clinic, interviewers met participants in a private and convenient location (eg, a private meeting room at a library).

Interviewers used a semi-structured interview guide which included 3 areas of inquiry: (1) electronic health assessment feedback (results from this published in a previous study) [14]; (2) adolescent preferences for health behavior change support from their provider (results from this have been submitted and are under review); and (3) technology used and preferences for technology use by adolescents for their health. Due to the large volume of data, this paper primarily focuses on the responses given to questions on the third area of inquiry with the specific questions listed in Textbox 1. For the first question, adolescents were asked if they had tried various technologies with card prompts to help orient them to the question. Cards included the following names and/or logos of social media sites or technology types: Facebook, Snapchat, Twitter, Instagram, live Chat (eg, via Skype or Gchat), wearable technology, wifi messaging (eg, Kik or Whatsapp), informational websites (eg, Google, WebMD, Wikipedia, ASKfm), texting service, save-for-later sites and apps (eg, Pinterest, Pocket, Digg), and blogs (eg, TeensHealth, Teen Speak, Tumblr). Interviewers defined "provider" to participants as their primary care physician or someone they see regularly for health check-ups, such as a pediatrician, family medicine doctor, or nurse practitioner. The interview guide was adjusted over the course of the study as questions were added to explore emerging themes or not asked about in-depth after reaching thematic saturation. Adolescents received $30 for participating.

Data Analysis

All interviews were recorded using a digital audio recorder and were professionally transcribed. Interviewers reviewed each of their transcripts for accuracy, correcting errors, and filling in gaps where possible. All interview transcripts were uploaded into the Web-based qualitative analysis software, Dedoose [15], for coding. One study team member developed the initial codebook of themes following a thematic analysis approach outlined by Braun and Clarke [16]. Using an inductive approach to data analysis, development of the final codebook was an iterative process, with coders proposing new codes to the study team as transcripts were reviewed, updating the codebook to encompass emerging themes and recoding previously coded transcripts. Four study team members participated in coding the data with 2 analysts independently coding each transcript, with coding discrepancies resolved by consensus. The authors collaboratively reviewed all text excerpts within each code to identify themes and key quotes illustrating each theme.

Results

Demographics

The mean age of participants was 15.2 years. As previously published, the sample included 20 participants who self-identified as Caucasian (64.5%), 6 as Hispanic (19.4%), 3 as Asian (9.7%), 2 as African American (6.5%), 1 as Other (3.2%), and 2 as Mixed race (6.5%); see Table 1 [14].

How Teens Use Technology for Health

Teens described using technology in one of 3 main ways to support their health: (1) to gather information, (2) to share their own experiences and view others' experiences in order to gain social support or inspiration, and (3) to track behaviors and health goals. Each of these uses is discussed below with illustrative quotes in text and additional quotes provided in Table 2. During these discussions, themes also emerged regarding the benefits and potential downsides to using technology for health. These are summarized in Figure 1 and discussed in the following two sections.

Information Gathering

Teens reported seeking resources, ideas, and education using both apps and websites. The most commonly searched topics reported by the youth interviewed were related to nutrition and exercise (ie, healthy foods, portion size, calorie counting, workouts); some also sought information on medical and mental health conditions and consequences to their health from behaviors such as marijuana use. To gather this information, teens reported using various sites including medical websites such as WebMD and Mayo Clinic, Web searches using Google, and Pinterest to "pin" or save healthy recipes or exercise routines. They found YouTube, exercise apps, and Facebook useful for accessing work outs; one teen also used Tumblr, a social media blog, for health information. Teens reported that they valued the accessibility and relatability of online health information:
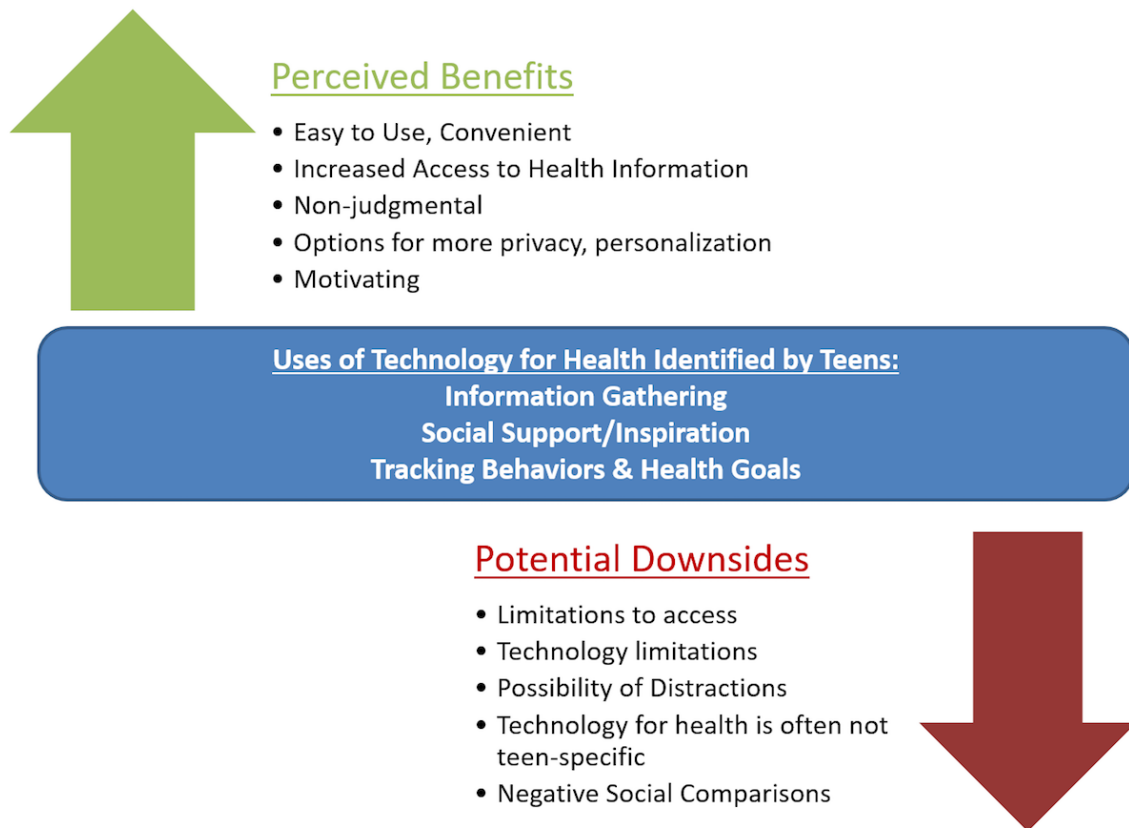
> *I don't have time and honestly don't want to go to the library to look up a disease. I like that everything is at my fingertips. So, if the doctor tells me that I'm at risk for this and I don't know the name of the disease, and maybe if the doctor is using fancy words that I don't understand. I think it's really nice that I can look up on Google, what is this? And like I'll get Yahoo answers, Google answers, but I honestly like it because it's like real people explaining compared to some weird terminology that I don't know.* [ID 925, Female, 17]

Table 1. Participant demographic data (N=31).

Characteristic	Participants
Age (years), mean (SD)	15.2 (1.4)
Age (years), n (%)	
13	5 (16)
14	5 (16)
15	6 (19)
16	10 (32)
17	4 (13)
18	1 (3)
Gender, n (%)	
Male	13 (42)
Female	18 (58)
Ethnicity, n (%)	
Hispanic	6 (19)
Non-Hispanic	25 (81)
Race, n (%)	
African American	2 (7)
Asian	3 (10)
Caucasian	20 (65)
Multiracial	2 (7)
Race not specified	4 (13)

Table 2. Uses of technology for health identified by teens.

Theme and examples	Example excerpts
Information gathering • exercise ideas, recipes, nutrition tips, etc • information about symptoms and treatment for common ailments; consequences of health risk behaviors	*Informational websites, WebMD is great. I've used it, it's awesome.* [ID 912, Female, 18] *I've used Facebook to help me with my health… there was this page about exercise and it had every day they would post little guides on how to do different exercises. I just subscribed to the page and would do the exercises when they came up.* [ID 924, Male, 15]
Social support/inspiration • ability to learn about others and relate to their experiences • viewing peer activity may inspire action; for others, did not make a difference	*If you see other people doing it, maybe pictures of other people doing something physical and they look like they're having fun [chuckle]. It might make you more motivated.* [ID 915, Female, 13]
Tracking behaviors and health goals • creating accountability through scheduling and reminders (especially for workouts) • using wearable technology to track activity • tracking nutrition via apps	*I like Nike Plus because…they give you reminders of like, "Remember you scheduled a run. Like, I would be training for a half marathon or something that I wanted to do once and it was giving me steps that I didn't have to figure out. It was easier for me… And then you get points for it. And like I said, I'm a competitive person so I would love to get as many points as possible. So, I liked that.* [ID 938, Female, 16]

Figure 1. Perceived benefits and downsides of technology use for adolescents.

Perceived Benefits

- Easy to Use, Convenient
- Increased Access to Health Information
- Non-judgmental
- Options for more privacy, personalization
- Motivating

Uses of Technology for Health Identified by Teens:
Information Gathering
Social Support/Inspiration
Tracking Behaviors & Health Goals

Potential Downsides

- Limitations to access
- Technology limitations
- Possibility of Distractions
- Technology for health is often not teen-specific
- Negative Social Comparisons

Inspiration and Social Support

In addition to gathering information, teens felt that they benefitted from others sharing their health experiences online, including: getting ideas of what others are doing to support their health; feeling motivated from others' shared pictures (eg, a friend who shared a picture from a half marathon on Instagram [Female, 18]); and feeling social support in their efforts toward better health, especially mental health. For example, one teen shared that Tumblr offers anonymity which allows users to be more comfortable sharing personal stories to wider audiences, as well as access to others who can provide online support:

> But then they get a good sense that they're not alone and maybe what that person's going through they can apply it to their own lives...Then when you're on your blog and then you read these things it makes you feel good that hey, I have someone I can talk to. [ID 922, Female, 14]

Although teens mentioned blogging as a way others could share their health experiences, many did not consider popular social media sites as a platform to learn about their health. Teens had various opinions on health technology which includes social components such as the ability to compare their progress with others. Some teens felt they could be inspired by viewing the health activities of others online: "Like well if that person can do it, I could probably do it too" (ID 919, Female, 17), while other teens were not particularly motivated by it:

> I don't think that would be a motivator force for me like it is for some people. Some people are like, "Oh,

these people are watching, so now, I got to go do it," and I'd be like, "Beep, the app's closed, whatever." [ID 928, Male, 17]

Tracking Behaviors and Health Goals

Some teens had used technology to track behaviors related to their health goals, such as steps taken, calories burned, portion sizes, water intake, and nutritional information. Various devices were used by the youth including wearables (ie, Fitbit), Wii Active plus, running apps, Google maps, Apple Health kit, Nike Plus, water consumption trackers, and My Fitness Pal. Notifications, reminders, and earning "points" from such programs were motivating to teens and prompted consideration of their goals during the day. Some teens appreciated the reward of receiving immediate feedback offered through tracking technologies:

> For me, there's definitely the gratification of like, "You reached 10,000 steps" and it goes off, and so you want to reach that. [ID 928, Male, 17]

Perceived Benefits of Using Technology

When talking about the different technologies used, themes emerged regarding characteristics that made health technology especially useful or appealing to teens (Table 3). Themes identified included: convenience, increased access to health information, the nonjudgmental nature of technology, options for increased privacy and personalization, and the motivating aspects of technological platforms.

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Table 3. Perceived benefits and potential downsides in teens' use of technology for health.

Observations and examples	Example excerpts
Potential benefits	
Easy to use, convenient • teens already using their phones and are proficient with technology • some apps are free	*...For the My Fitness Pal thing, having it all in the phone because you always have your phone. So just always having that information with you and it's not on paper or on something that could get damaged...I like technology, as opposed to paper, I'd probably choose technology.* [ID 935, Female, 16]
Increased access to health information • credibility of information important • explained in an understandable way • information is shareable • tracking information brings awareness to eating habits	*...I don't have time and honestly don't want to go to the library to look up a disease. I like that everything is at my fingertips. So, if the doctor tells me that I'm at risk for this and I don't know the name of the disease, and maybe if the doctor is using fancy words that I don't understand. I think it's really nice that I can look up on Google, what is this? And like I'll get Yahoo answers, Google answers, but I honestly like it because it's like real people explaining compared to some weird terminology that I don't know.* [ID 925, Female, 17]
Nonjudgmental • not a parent or teacher telling teen what to do • technology could relieve teens from seeing unwanted reactions from providers during face-to-face contact	*...Like some teachers are really biased about it because they are against having sex at a young age so they don't teach you what your other options are, they just say, "Don't have sex." Same like with learning about our bodies, like in health they don't teach you the parts of the vagina or the vulva or stuff... I had to learn a lot of that stuff on my own. I looked it up. I wanted to know what parts there are so I looked it up...on Tumblr. There are a lot of good references in there.* [ID 933, Female, 15]
Options for more privacy, personalization • ability to ask questions or seek information anonymously • ability to share or repost useful information	*Well I guess you can hide behind the screen I guess...They don't need to know; like you don't need to see people in order to talk to them...it's just like you don't have to worry about what to wear.* [ID 913, Female, 13]
Motivating • creating competition via tracking points or setting personal goals • providing positive reinforcement	*[Nike running app] just tells me how much I run and gives me feedback...It'll say like, "Keep going, you are doing great." Something like that. Positive feedback...Because then you think in the back of your mind, "Oh yeah, you can really keep going and keep going and push harder."* [ID 914, Male, 16]
Potential downsides	
Limitations to access • difficult to find credible health information • apps and tracking technologies often come with costs teens cannot always afford	*When you search up something it doesn't really give you the right answer sometimes.* [ID 910, Female, 13] *...WebMD as far as I know it just tells you you have cancer. I don't actually know if it does anything helpful.* [ID 924, Male, 15]
Technology limitations • having to frequently input information • prone to inaccuracy (not having the right foods to log, pedometer sensitivity) • need to remember passwords	*The food diary wasn't very accurate because if you type in "cheese," like if you have a sandwich you have to put it in piece by piece and that's kind of annoying, and you always have to remember if you go for a walk to turn on the step counter, but that's pretty much for anything. Overall it was a really good app, but it was just a bit too much extra work for eating and walking. If I eat a sandwich I don't really want to put it in before I forget.* [ID 936, Male, 16]
Possibility of distractions • use of technology for health could draw teens into using phones for example for more entertainment, reducing sleep and activity	*I think it [technology] kind of makes them [teens] more unhealthy because it will stop them from sleeping. Sometimes if my phone starts vibrating and I'm half asleep, I'll wake up and look at it.* [ID 936, Male, 16]
Technology for health is often not teen-specific • tracking technology is usually focused on weight loss instead of consuming healthy foods • may be too private or not private enough	*I used [My Fitness Pal]...I also felt that it was motivation in the wrong direction. Like tracking everything that I was eating and mixing all the nutritional information compatible together made me want to eat less which is not good. So I stopped using those apps because I just didn't think they worked for me the way that they were supposed to...I feel that a lot of those apps are focused on losing weight rather than a healthy lifestyle and they don't really give any tips for a healthier lifestyle.* [ID 931, Female, 14]

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Observations and examples	Example excerpts
Exposure to risky behaviors; negative social comparisons • teens may see unhealthy messages through peer use of technology • teens may misuse technology to continue health risk behaviors	*Instagram—I don't see how that could help with health. Have you ever heard of the thigh gap? No? So basically what it is...I was on Facebook and someone liked a photo from Instagram and it showed this picture with her feet put together and a gap between her thighs. I can show you [stands up and gestures to thighs]. So it's like your feet are together and there's a gap right there. And that's called the thigh gap. That came through Instagram. A lot of people were doing a lot of unhealthy things to achieve that.* [ID 912, Female, 18]

Teens valued technology that was easy to use and fun, especially using games and earning points or rewards which could help them set personal goals and motivate them to do more the next day. Teens appreciated having multiple options of things to do, like exercise routines (eg, Pinterest), and integrating multiple aspects of health data such as calories, exercise, and body mass index. Other appealing characteristics included social support, reminders, getting positive feedback, privacy, and convenience, especially due to the ubiquitous nature of technology:

> *I think it's nice because for most teens it's in the palm of your hand. You can do it while you're out. It's not like you're like literally carrying a journal around and writing it down. It's discreet, other people don't necessarily know what you're using.* [ID 917, Female, 17]

Participants appreciated the way technology made health information easily accessible, understandable, and shareable; they especially valued sources focused on health concerns, such as WebMD, to explain health terms regarding diseases or medications which their provider may have quickly gone over in the clinical setting. One teen specifically preferred the neutrality of phone notification reminders as opposed to human verbal reminders which may come off as admonishing:

> *Like the reminders help instead of having a person do it because they could be like, "I told you to do this six times and you didn't do it," and my phone [can] just like nicely be like, "You have not done this yet, you need to do this." Be like, "Well, okay." Because positive reinforcement—at least for me—is better than somebody yelling at you and saying, "No, you have to do this and you haven't done this yet, and I'm disappointed."* [ID 926, Male, 16]

Anonymity was valued by teens when discussing personal health information, with notable differences between social media sites in potential for unwanted disclosure:

> *In Facebook, the settings are twisted a little bit so I would be afraid to make a mistake and all of a sudden everyone knows...you have that different identity on Tumblr so say that Pixie12 is talking to her doctor, but you have no idea who that is so it doesn't really matter.* [ID 938, Female, 16]

Potential Downsides to Technology

Several teens described that although technology could be used for health, they also recognized possible downsides, as shown in Table 3. Some factors which kept teens from using certain technologies included: limitations to access such as cost; limitations to the technology itself such as requiring remembering log-ins and passwords or the requirement for frequent or complicated data entry; the possibility of distractions; technology for health not being teen specific; and negative social comparisons. Several teens felt that wearable technology would be useful but, because of the cost, viewed it as inaccessible. Others were frustrated by the lack of accuracy and user-friendliness of the freely available apps:

> *There is a health app that comes on the iPhone, but it's really inaccurate. Like the steps you are taking, it doesn't accurately count them so it's kind of useless, and I don't know how to use it.* [ID 933, Female, 15]

Teens mentioned that if they were drawn to use their smartphone for health, they also may be alerted to other applications and notifications and then use the phone for longer than intended. One teen described how her intention to engage in a healthy behavior (exercise) may be disrupted by smartphone distractions which she feels are difficult to control:

> *You might get like, "Oh yeah I'm going to go work out." And I've got my phone and it gets in the way because you get sucked in and it's hard to get off. It's addicting.* [ID 935, Female, 16]

Another teen made an insightful point that while using technology offers the privacy for a teen to explore and gain knowledge on something they might not otherwise have the courage to ask about; this unmoderated access to information may impede seeking input from others.

> *You can put yourself in an environment where no one else knows what you are doing on the computer, and so that's a good thing and a bad thing in my opinion. It's a good thing because no one has to know that you are struggling with this problem—[using the internet] could then give you more knowledge on what is happening with you to make a change instead of just ignoring it like you probably would have. But it's also bad because no one knows what you are looking at so you can look at anything.* [ID 938, Female, 16]

On the other hand, some teens felt their privacy would not be completely protected since searches may be visible on their browsing history. For example, one teen stated:

> *A lot of kids don't want to go on their iPads and search "birth control" because it's on the history.* [ID 917, Female, 17]

Some teens also mentioned the potential for negative consequences from technology-based health information, such as sharing risky behaviors, promoting body dissatisfaction and negative competition, losing weight in an unhealthy way, and being exposed to bullying.

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Technology for Health Provider Communication

In addition to questions about history of use, teens were asked how they may consider using technology for working with their health provider and what types of technology they would like to use. Three main categories for potential uses of technology with their providers emerged: (1) to have questions answered by their providers outside of visits; (2) to have greater access to their providers as a way to build their relationship/rapport; and (3) to share data regarding their behaviors in between visits with their provider (Table 4).

Several teens spoke about a desire to use technology to get quick and direct responses to questions in between visits. They felt they would benefit from receiving guidance from their provider on reputable internet resources when conducting a search for health information; and from receiving immediate feedback from their provider on whether the severity of a clinical problem warrants an appointment. Teens particularly valued the ability to receive a rapid response to their questions directly from the provider and not another staff member.

> *If there was an option where I could email my doctor questions I think I would probably do that. And they've never said that they're like, "Call us if you have any problems," but when they say that they mean call the doctor's office and make an appointment, at least from my perspective they're not just there to talk. But, let's just say if I had a question if it was possible to email them and get a direct response.* [ID 917, Female, 17]

Preferred technological methods to communicate with a provider varied among teens. Factors affecting preference included the type of question they had as well as the teens' thoughts regarding formality of the interaction. Many teens indicated a preference for text messages when the communication was brief or simple such as in scheduling appointments, prescription reminders, and answers to straightforward clinical questions. They also felt that due to text messages being more informal, they would also be more authentic:

> *So with a text you can text whatever you are writing, you don't have to worry about saying, "Dear Dr. Blah, Blah, Blah," and then if you need to add in one more sentence you don't need to send a whole new email, you just have to add one more sentence. You can just sort of put it in there. It doesn't look super bad...being less formal is better because when you feel formal you feel the need to be perfect and that's not true.* [ID 938, Female, 16]

At times, teens preferred phone or email when they wished to show the provider they had taken more effort to contact them and compose a message when compared to texting. For more complex questions that might require detail or a lengthy

response, teens preferred email communication, in order to safeguard against losing meaning and also to save the information for reviewing in the future. One teen described that opposed to the phone, email could also offer more privacy and its asynchronous nature could help avoid embarrassment:

> *I just feel like it's [email] almost more like private, and I think it's easier for long responses. If I had a question that they could send me a link to it, it would still be on my phone. I could check my e-mail on my phone. It still would be right at my fingertips, but it would be a little more confined, I guess. It wouldn't be talking on the phone about it as much if it was something I was kind of embarrassed about. I wouldn't have it in text message. Text messages are kind of hard. When I text, I'm not having in-depth conversations with people. It's to have a short little thing. I just e-mail when I have—when it's longer. More important things I guess.* [ID 917, Female, 17]

Finally, some teens preferred video conferencing as they felt it was important to see facial expressions and nonverbal cues:

> *Seeing someone else's facial expression is very important. If you are just texting, a lot of people use shorthand [which] can kind of erase elements of conversation so maybe you can't tell if someone is being sarcastic and you write it down. Like, I totally have this issue. "So, do you sleep well?" "I haven't slept ever in my life." That's obviously sarcastic, but "Did you sleep well last night?" "No, I got up and died" or, "I got up and fell over and hallucinated." You know, something crazy and they accidentally break that down and take it seriously. But, over Skype you can see their face and they can be smiling or laughing or making sarcastic eyebrows, you know what I mean? So that can be helpful.* [ID 930, Male, 16]

Social media was not a preferred method for communicating with the providers for any of the interviewed teens due to concerns about privacy and intrusiveness.

> *I think it [social media] could be done I just don't think it's a preferred way to—because I feel like a lot of teens would think that it might be an invasion of their privacy if their provider followed them on all their social media. Then it might be kind of awkward.* [ID 915, Female, 13]

A recurrent concern that arose about using any technology to communicate with providers was potential loss of confidentiality. However, the asynchronous and nonjudgmental nature of electronic communication methods had the advantage of reducing discomfort when teens were anxious about disclosing a sensitive clinical topic.

Table 4. Technology for health provider communication.

Categories for Use	Example excerpts
As a way to have questions answered by their providers outside of visits • Use of technology could potentially reduce appointment frequency	*...Say you are on good terms with [your provider] and you have some weird boil or whatever, take a photo of it say this hurts, send it to them and they would tell you what they think it is. Kind of like a WebMD that works.* [ID 924, Male, 15] *Like today I could have stayed home and could have talked to her over the computer instead of coming in for her telling me that I need to do more...For easier appointments, it could be easier to do Facetime. Like not-so-hard appointments where the doctor needs to see exactly what they need to do.* [ID 914, Male, 16]
To have greater access to their providers as a way to build their relationship/rapport	*I think, especially if they want to be more one-on-one and know every patient that they have, if they're kind of connected and seeing those results, the patient is kind of like earning or like Fitbit gives you little badges, maybe the health care providers like, "Oh, he did this, this was on the plan, let me send him this little badge," and it'll be like, "Wooh"...Stuff like that, or really more personal with the doctor than just being like, "Yeah, I show up at your office every 6 weeks and I have to be here," but actually being connected.* [ID 928, Male, 17] *...So, maybe a monthly email checking in or something would be good, because then I'd know that this [provider] cares about me as a patient instead of just, "I blend in with all these other kids."* [ID 940, Female, 14]
Share data regarding their behaviors in between visits with their provider • As a way to communicate or provide proof about their behavioral patterns	*...But I actually have information now. So it puts information from the [Jawbone] UP into my iPod and I can show that to my doctor and be like this is my sleep from the night that we just had, this is my sleep from last week, this is my general pattern. Let's talk about that. That's been nice.* [ID 912, Female, 18] *I think it's [Owl outcomes app] useful because you can monitor how you're doing without having to actually go to the doctor's like every 2 weeks. You can go like every 2 months and still have them know if something's going really bad, then they can contact you.* [ID 915, Female, 13]

An additional benefit for some teens was the possibility to connect more personally with their doctors between visits. Teens felt technology offered an opportunity to further build rapport with their provider, particularly if the provider were to reach out to them in between visits. One teen described the possible content of a monthly check-in email:

> *"Hey, how's your week? Do you have anything new? Do you want to give me a phone call? Is there something we need to talk about? What was your favorite part of this week?" Something where you can build up that relationship and trust, and it's not only associating the doctor with taking your temperature and stuff that hurts.* [ID 940, Female, 14]

A final area in which teens talked about the potential for technology to be helpful was in helping them document and share their health behaviors with their provider. Teens felt that tracking such information could help provide objective data to the provider and validate steps they were taking toward behavior change, as well as potentially decreasing the number of in-person visits.

> *You can kind of keep track [on FitBit] of what you are doing, and the fact that you can log it on your phone, and then you can go back and see what you did, and you don't have to always try to remember that part of it...It's like actual proof because sometimes if you're like, "Yeah, I went and walked five miles one day," the doctor's like, "Did you*

really? You don't look like you'd be that person," then you'd be like, "I did." [ID 928, Male, 17]

Discussion

In this qualitative study, teens indicated 3 main categories of technology use for health: (1) gathering information, (2) inspiration and social support, and (3) tracking health behavior and goals. Teens expressed their desire to quickly access nonjudgmental health information in the privacy of their own technology use, but noted some shortcomings of technology for health including prohibitive cost, technology not being youth-friendly, potential for distraction, and exposure to negative behaviors, especially social comparison. Teens were interested in using technology such as email or texting for communication with their providers specifically as a way to get questions answered outside of visits, to have access to their providers to build the teen patient-provider relationship, and as a way to keep their provider up to date with sharing information about progress in health between visits.

In our study, the most commonly mentioned use of technology for health involved use of search engines and websites to learn about health-related issues. This is consistent with a prior study of a nationally representative sample of US teens which found that the vast majority had used the internet for gathering information on their health, despite only 25% being satisfied with the information they found in searches [2]. The perspectives of teens in our study suggests that this may be due to technology for health not being teen specific and written for adult audiences.

This implies that technology developers should include teens in their user-testing and specifically consider their unique needs and reactions. Also, health care providers should assume their patients are using the internet to answer their health questions and check in with them regarding what they have learned and help direct teens to sites that tend to have more reliable and age-appropriate information. Additionally, health care providers and health educators have a role in helping teens develop skills in assessing online health information and health literacy.

Another key finding of our work was that although adolescents appreciated some of the social aspects of technology such as learning about their friends' health accomplishments or feeling they are not alone, for example in mental health symptoms, most did not prefer to use their social media for health and did not want to use social media for communicating with their provider. These results are consistent with a recent cross-sectional survey of adolescents attending a primary care and adolescent clinic in which only about a quarter thought social media would provide useful health information and most would not want to use it to communicate with their provider [17]. Several other studies have also found teens prefer health interventions which do not use their existing social media [3,18,19]. Our study provides an explanation as to why social media does not seem to be the preferred medium for teens. Several youth expressed concerns regarding mixing their private social networks, which they saw as mostly focused on connecting with peers and friends, with health-related initiatives. In particular, adolescents were concerned about their peers seeing health-related information or their providers seeing information intended for peers. Despite these concerns, there still may be a role for social media in health promotion, as several studies have shown teens will engage with others who have a similar health problem in privately moderated social networks [20-22]. Also, in one study, Facebook-based health education posts related to sexual health risk were accessed by teens when the content was obtained in a more passive manner and not shared with their social networks [23].

While recognizing how popular and intriguing technology was to them, teens in our study also identified several possible downsides including distraction from important tasks, such as school work, sleep disruption, and exposure to negative content (eg, risky behavior and overt focus on body image). Increased technology use, especially prior to bedtime, has been associated with sleep disruption [24]. When providers consider the use of health technology with teens, it is important to also be aware of these potential negative effects. For example, if recommending a calorie-counting app or online tool when counseling about behavior change related to weight loss, a provider may consider a discussion about body image and any associated advertisements the tool may have regarding unhealthy dieting. The provider may also help the adolescent think about whether tracking their weight loss with friends through the app may lead to negative social comparison and unhealthy advice on disordered eating or over exercising. Another role for the provider may be to help the adolescent set appropriate goals, knowing that many of the default recommendations used by these tools may be designed for overweight or obese adults.

Although teens recognized potential downsides, many were enthusiastic about using technology to communicate with their provider. Their goals for using technology with providers largely paralleled the reasons they used technology for general health, including getting questions answered outside of visits (gathering information), connecting and building rapport with their provider (inspiration and social support), and sharing data in between visits (tracking behaviors and goals). There was no consistent preference for one type of technological medium (eg, phone, social media, text message, email) for communication over another. More important to teens seemed to be the nature of the content of the communication. As providers consider adding technology, they may want to seek youth input regarding preferred methods. Preference to use technology to communicate may vary based on the health topic [3] and the type of information being exchanged. For example, although teens prefer receiving their sexually transmitted infection test results face to face [25,26], an anonymous question and answer sexual health web portal was very popular [27]. A large multiple focus group study done with adolescents in Ontario similarly found that communication via technology can allow providers to enhance connection and trust with their teen patients and help provide direction to searches and how to critically appraise online health information [28]. Health care providers may not realize the value of using communication through technology to build rapport with their teen patients. To allow for more informal provider-teen interactions, secure messages through patient portals seem to be less used by teens [10], but this may not be because teens do not want to communicate with their provider but possibly due to patient portals not being convenient and as easy to use as communication methods teens are accustomed to (eg, Facebook messenger) due to security standards. Also, the language used to present health information on these portals and website format may not be as easy to use, approachable, and visually pleasing as popular health education websites for young people, such as the online birth control support network, bedsider.org.[29]

This small qualitative study is limited by use of a sample recruited from an urban academic health clinic, and it is possible that the views of adolescents living in rural settings with less access to health care may differ. While our purposive sampling method helped to generate a sample that was representative with a range of respondents, this methodology may be prone to researcher bias. However, our findings are similar to those of a larger quantitative study where samples were recruited from a nationally representative population [2]. Another limitation is that teens in this study were given prompts for particular technological platforms and so they may not have considered other technologies which did not immediately come to mind. In addition, it is possible that taking the health assessment primed teens to be more accepting toward technology for health; however, since most had used technology for health in the past, we do not think this would have biased their responses significantly.

Conclusion

Overall, teens use of technology for health is growing. Health care providers should be prepared to inquire about and provide

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advice for how teens are using technology for their health. Teens would like to use technology-based communication tools with their health care providers. This study offers multiple implications for health providers caring for adolescent patient populations and technology developers. First, providers should assume that teens have used or will use the internet to answer health-related questions and should be prepared both to assess the teen's understanding and to help guide the teen to reputable sites. Anticipating these health searches, health care providers can provide specific guidance including directing teens to trusted websites and assisting teens to use the best health-related terminology. Additionally, when recommending sites, providers should also consider any potential negative consequences and check in with teens regarding their experiences, both positive and negative, with using any recommended sites. Finally, teens are interested in using technology to communicate with providers. Technology developers should consider building more options for teens to communicate with health care providers. As technology grows, more work will need to be done to help providers understand and respond to youth preferences, to develop tools to guide youth to reputable health resources, and to develop strategies for incorporating patient tracking data into clinical practice.

Acknowledgments

Conflicts of Interest

CM's spouse is employed by Facebook, and together they own stock in Facebook.

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