Adolescents With Asthma: Learning Needs and Internet Use Assessment

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OBJECTIVE: To identify particular learning needs among adolescents with asthma and explore the potential utility of the Internet in addressing adolescents' expressed learning needs. METHODS: In 2004 and 2005, 6 gender-specific and age-specific focus groups were conducted among adolescents, ages 12–18 years, with mild intermittent to severe persistent asthma. Thematic analysis of participants' statements from transcribed group sessions were conducted by the research team, who compared field notes, reviewed focus group transcripts, and validated emerging and final themes. RESULTS: The majority of participants denied previous experience with formal asthma education. Participants reported their limited knowledge of asthma and its management. Health-care providers were recognized as the most credible source of asthma information. Compared to the older adolescents, the younger adolescents expressed stronger motivation to learn about asthma. The participants identified asthma learning needs for others, including peers, teachers, and parents. The importance of socialization, support, and information-sharing with other adolescents with asthma was perceived by participants in all age and gender groups. Participants discussed their Internet use and articulated suggestions regarding potential uses of the Internet to assist in adolescent asthma management. CONCLUSIONS: This study underscores the necessity of an early intervention to take advantage of younger adolescents' greater interest in learning about asthma, and highlights the importance of incorporating peer dynamics in designing interventions for adolescents. Our findings also illustrate the variety of ways that the Internet may be useful in developing a technology-driven intervention for adolescents. *Key words: adolescents, asthma, education, learning, Internet, focus group*. [Respir Care 2006;51(12):1441–1449. © 2006 Daedalus Enterprises]

Introduction

Asthma is one of the most common chronic conditions among children and adolescents.[1] For children under the age of 18, the lifetime diagnosis rate is 9 million (12%); more than 4 million children (6%) have suffered recent asthma episodes.[1] According to the 2002 National Center for Health Statistics,[2] pediatric asthma accounted for 5 million physician visits, more than 727,000 emergency department visits, and 196,000 hospitalizations. Estimated annual health care costs for treating asthma in children in the United States during 2001 were $3.2 billion.[3]

Despite improved treatment options, asthma morbidity and mortality continue to be major health issues for young people. Adolescents are known to be at greater risk for poor asthma outcomes because of counterproductive self-management behaviors such as smoking and nonadherence to treatment.[4–8] Parents also become less confident in their ability to manage asthma in their adolescents.[9] The National Asthma Education and Prevention Program's Expert Panel Report[10] recognized particular difficulties in managing adolescent asthma, contributing to poor control. Therefore, effective education strategies that

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address adolescents' particular learning needs are needed.

Adolescence is an important period for implementing health education, because lifelong patterns of health habits and behaviors are established during adolescence. Adolescents can consolidate health-related values, attitudes, and lifestyles, and make decisions about various health behaviors that have important consequences for future health.[11] Coping styles and self-management of and adjustment to chronic conditions also begin to consolidate and are established in adolescence.[12,13] Moreover, most adolescents are cognitively capable of considering multiple elements simultaneously, which allows them to systematically integrate diverse components and situations in asthma management decisions. Abstract and logical thinking develop during adolescence, which presents an opportunity for education about complicated mechanisms involving asthma pathophysiology and medication and for building effective problem-solving skills through comparing and evaluating different hypothetical situations. Capitalizing on these emerging cognitive abilities in adolescence may augment the benefits of asthma education programs that promote self-management.[14] Despite the cognitive readiness exhibited by young people, development or evaluation of asthma education programs exclusively targeting adolescents has been largely neglected in the literature.

Information technology has become an important tool for children and adolescents. According to a recent report by the National Center for Educational Statistics, based on data from the 2001 Current Population Survey,[15] about 90% of children and adolescents ages 5–17 years use computers, and at least 75% of teenagers access the Internet. Thus, traditional sources of health information alone no longer meet teenagers' needs and have been replaced by information technology,[16] widely recognized as a potential medium for providing health information in various health/illness-related situations.[17] According to a recent report, over 70% of teenagers use the Internet for health information.[18] Given its popular accessibility, attractiveness to adolescents, and versatility in terms of features and potential utility, information technology is a promising tool for addressing learning needs of adolescents with asthma. Although several researchers have used computer-assisted techniques (eg, CD-ROM) to provide asthma education for children,[19,20] there has been limited research on the potential utility of Internet applications for adolescents with asthma.

This study used a retrospective descriptive approach,[21] using researcher-provoked data. The descriptive approach is intended for use in topics that have not been researched extensively or where the point of view of individuals who experience the phenomenon has not been well described, as in adolescents' experiences with asthma. Using a focus group method, the purpose of this study was to identify particular learning needs among adolescents with asthma and to explore the potential utility of information technology in addressing adolescents' expressed learning needs.

Methods

Study Design and Participants

A qualitative descriptive study, using focus group interviews, was used to explore the asthma learning needs and Internet use and preferences of adolescents with asthma. Focus groups were organized by both gender (ie, boys, girls, and mixed-gender groups) and by age (ie, 12–15 y and 16–18 y) in 2004 and 2005. Recruitment was conducted through the use of flyers posted in asthma and teen clinics, recruitment letters sent through local school nurses, and a community contact teen. Interested participants contacted the study team by telephone and were screened via a return telephone call from the primary investigator. A patient was eligible if he or she (1) had physician-diagnosed mild intermittent to severe persistent asthma, (2) did not have other physical or cognitive-mental illnesses, and (3) was able to communicate in English. Eligibility was verified by self-report from parents and participants. All individuals contacted were deemed eligible and were included in the study. A total of 19 participants attended one of the 6 scheduled sessions: older girls; older boys; older mixed-gender; younger girls; younger boys; younger mixed-gender. The mean ± SD age in the younger groups was 13.4 ± 1.01 years, and 16.5 ± 0.71 years in the older groups. Eight participants were boys, and 9 were African American.

Procedures

Each focus group was led by a facilitator, who was gender-matched to the participants. The focus groups were held in a local teen health center in the community or in the principal investigator's affiliated university setting. Group facilitators (one female and one male graduate student) participated in a training session structured by the principal investigator and other members of the study team, based on the available literature.[22] Collectively, the research team has expertise and previous experience in adolescent health, asthma, and instructional technology research, and in focus group methods and qualitative data analysis. After being contacted by interested adolescents and/or parents, potential participants were screened for eligibility and provided with information on the purpose and procedure of the study. Participants were assigned to one of 6 groups, by their gender and age. No participants or parents had personal acquaintance with any of the study team members before the group meetings. Prior to each group session we administered a survey questionnaire to

collect sociodemographic and asthma-related data, and refreshments were offered to enhance the informal atmosphere. Before each session, participants were given a brief description of the study and a chance to ask questions related to the study. Each session was structured by specific questions to probe their learning needs (eg, How do you usually learn about asthma? How do you feel about learning about asthma that way? In what ways would you prefer to learn more about asthma?) and Internet use (eg, What do you use the Internet for? What ways do you use the Internet to help you deal with asthma?). Focus group facilitators supplemented each major question by using transition, clarifying, challenging, and probing questions to obtain more accurate and in-depth responses.[22] Each focus group lasted approximately 45–60 min, excluding a 10 min warm-up session. The group discussions were audio-taped and transcribed verbatim. Participants received a $15 study incentive, in the form of a gift card, for attending. Post-session study team debriefing took place after each focus group. Debriefing notes and study team members' field notes were used to enrich interpretation of the transcribed data.

Human Subject Protection

The study protocol was approved by the institutional review board. Informed consent and assent were obtained from parents and adolescent participants, respectively. Participants were assured of the confidentiality of information provided, and permission was sought for tape-recording the discussion. Participants were addressed by self-selected pseudonyms throughout the discussions on the audio tape and were instructed not to share information discussed during group sessions with others, to assist in ensuring confidentiality.

Data Analysis

The transcriptions were reviewed by the study team for completeness and accuracy. In addition, field notes recorded by the research team allowed comparisons of the overall atmosphere of the session and participants' nonverbal behaviors. Researcher debriefing sessions took place immediately after each focus group session to facilitate identification of overall preliminary themes. Data were analyzed by 3 independent researchers. The following analysis methods were employed by each researcher. Each transcript was first read in its entirety for initial descriptions that answered questions asked in the interviews. Then the responses were subjected to textual line-by-line analysis, with the goal of revealing and refining categories in those answers. Prior to data analysis, transcripts were imported into software (Folio Views 4, NextPage, Draper, Utah), to facilitate systematic management of the qualitative data.[23] The software used allows organizing the data based on groups and questions and facilitates data comparisons via query functions. It also allows recording and updating codes or categories attached to individual paragraphs in the database as they emerge while reviewing transcripts.

The following steps and software functions (in parentheses) were applied during analysis: identify smallest units of meaningful dialogue or "strips" (highlighters);[24] group the strips into categories based on similarities, and group similar categories into themes (highlighters, notes, contents, links, searches, and queries); and specify relationship(s) between themes within participants' context (notes, contents, searches, and queries).[25] This software is solely user-driven in the choice of thematic decision making and linking capabilities. Descriptive summaries were created and refined based on final categories by the researchers.

Results

Sources of Asthma-Related Information

When asked about participants' prior experiences with or involvement in formal asthma education, the majority denied prior exposure to any structured asthma education. In fact, a number of participants stated that they were not even aware of any offer of such opportunities. One of the younger girls had participated in an experimental computer-based asthma program, and an older boy had attended a short asthma awareness session offered at a Boy Scout camp. Only one older boy had attended a specific asthma camp, at which he met other children with asthma and learned about asthma. Participants admitted having a limited knowledge base, particularly related to pathophysiology of asthma symptoms and mechanisms of asthma medications. Reported asthma knowledge was primarily focused on inhaler use, which was obviously seen as the key to asthma management among participants in all groups, although this knowledge was primarily reported as practical knowledge. All participants were able to identify asthma symptom triggers (eg, smoking, weather, and exercise) based on firsthand experience. Participants candidly admitted their lack of knowledge on asthma and its management and perceived the need for asthma education.

Despite a recognized lack of knowledge across all groups, older adolescents, in general, presented with passivity regarding obtaining asthma information, and asthma education was not perceived as a necessity. Participants responded that they rarely discussed the illness with either their family members or close friends. Instead of investing active effort, they preferred information to be streamlined by others who they perceived as credible and understanding. On the other hand, younger adolescents tended to express more interest in learning about their illness by engaging in

some form of active learning. Younger adolescents reported having read books, information brochures from clinics, browsing asthma-related sites on the Internet, and sharing tips from friends with asthma in order to understand and manage asthma better. Younger adolescents expressed motivation and enthusiasm to learn about their asthma, as well as some disappointment when learning needs were not fulfilled. This point was well reflected in a statement by a member of the younger girls' group: "I had a lot of questions and, in a way, I felt like I didn't have anyone to ask."

Some young girls responded negatively about attending health classes at school, where asthma had been presented as a topic. They were skeptical about the credibility or adequacy of the instructors (usually gym teachers) providing the information.

> Sometimes it was just kind of annoying; like, you don't expect gym teachers to know all about asthma unless they actually experienced it or studied it or whatever, and they are kind of like acting like they know everything that is going on and stuff.

Although younger and older participants of both genders identified health-care providers (eg, doctors and nurses) as a credible source of information, none reported receiving substantial or satisfactory information from those individuals.

While a surprising number of participants in all groups reported not having any discussions about asthma with friends or family members who had asthma, some participants expressed a reliance on families and, to a greater extent, friends, for support and information related to asthma symptom management (typically, inhaler use). Participants appeared to be generally comfortable talking with family members who had asthma or who were employed in health professions (eg, nurses, pharmacists) about their asthma, but reported engaging in these discussions infrequently. Friends with asthma emerged as the best source of information and advice for these adolescents, among all the groups. One participant said,

> My friend has really really bad asthma. . . so I've kind of just learned off of her." Another said, "One time my friend who had asthma said it helped him to use the inhaler before doing something and that helped him, and then I tried that, and it helped me too.

Learning Needs for "Everyday People"

Participants were generally most vocal about the learning needs of school personnel (eg, classroom teachers, coaches, gym teachers, school nurses), with whom they interacted daily. Misunderstanding or lack of knowledge about asthma among these adults often caused frustration and annoyance in the adolescents. The ignorance in "everyday people" sometimes resulted in emergency use of health-care facilities.

> I was in a class sitting down, and they still don't know what triggered it inside the classroom, so that's frustrating. It's like they just don't know, so I had to be rushed to the hospital in an ambulance.

Participants in the younger groups discussed inefficient handling of their asthma by school nurses, and they pointed out the need for further nurse training about asthma. They reported that school nurses sent them to the hospital even with minor symptoms or became uncomfortable in handling asthma symptoms.

> She [the school nurse] went really, really berserk. She almost had a nervous breakdown, like that had never happened before.

Sadly, many participants shared similar feelings, such as the young girl who said, "Our nurse doesn't help. I don't think she is someone you can talk to."

Lack of knowledge in family members was also evidenced. Two male participants indicated that they were exposed to passive smoking at home, with parents being the offenders. To avoid this situation they often isolated themselves from the smoking parents. Parental disbelief or denial was also reported by an older girl who had an adolescent onset of asthma. Parental lack of understanding and support contributed to adolescents' frustration and added difficulty to proper asthma management in situations such as the following, reported by a younger girl.

> I really don't think my dad understands, because, during my softball game . . . I started having an asthma attack, but I didn't want to come off the field, because he gets mad when I take myself off the field. So I would just stand there and start to cry . . . and he's, like, what's wrong? And I would think he would know, and he just looks at me like he doesn't really care about what's wrong.

Peer Influences on Learning

Peers were repeatedly mentioned as the most important source of information, by participants from all the groups. Information from friends who had prior experience dealing with severe asthma was particularly valued by participants.

> I'd probably start . . . asking one of my friends. He has it really bad, and I ask him how does he feel

> about it and has it affected things he does, because he can't do really that much because he has it really bad, and it doesn't take that long for him to do something, he has to go take his inhaler. So I figured that I'd ask him and see if he knows what causes it and what does he do so he doesn't have to use his inhaler that much.

In addition to information needs, participants appreciated companionship with peers with asthma. Younger participants described the importance of having friends who also have asthma and shared difficulties related to having friends without asthma. One said, "When I tell my friends about that kind of stuff they freak out; well, some of them do." Participants from all groups valued friendship with peers with the same illness; it appeared that these interpersonal relationships alleviated feelings of isolation and helped them embrace differences caused by their disease. Some expressed their wish to have more opportunities to meet with asthma peers with whom they can freely talk about their illness.

> I think this is the most helpful that I've ever had, talking to other people and knowing that there's other teens out there that have the same exact thing: problems—knowing that other people are there that don't have, or that have, similar traits.

For older participants, even those who rarely conversed with peers about asthma, having friends with asthma provided them with a feeling of mutual understanding and support.

> I have 2 friends who have asthma, and we don't really talk about it, but we know we have it, and we know it's there, so we know if we need someone to talk to that knows what we're going through, they are there.

Overall, older participants expressed more interest in having teens come together to share their experiences with asthma, and they expressed and exhibited more enjoyment from the focus groups than did the younger participants.

Learning Content

When asked what they wanted to learn, participants expressed interest in learning about the etiology/pathophysiology of asthma, long-term complications, and pharmaceutical treatments (eg, types, mechanisms, administration techniques, drug interactions, adverse effects). Older participants were also intrigued by alternative ways of dealing with asthma; one participant described "farmer's tricks," particularly when inhalers were not available. Helpful breathing techniques and drinking soda were mentioned as examples. Participants shared their experiences of forgetting to take preventive measures such as carrying and/or using medication. Thus, learning needs for strategies facilitating adolescents' attention to timely self-management behaviors were suggested.

Receptivity to Asthma Education Via the Internet

All participants had access to the Internet, at school and/or at home. Consistent with national statistics,[15] the majority of participants (13 of 19) reported frequent Internet use (every day or every other day). Participants reported using the Internet for various purposes. Fifteen of the 19 participants had used the Internet to find new information. Their most common Internet use was communicating with friends via e-mail or instant messaging. Participants reported using the Internet occasionally to complete homework assignments, play online games, gather information, shop, or download lyrics.

Participants were, in general, more receptive to the possibility of using the Internet to obtain information about asthma, although none in the older groups had previously used the Internet to locate information on asthma. They wanted the potential asthma Web site to be entertaining ("Something that will keep people our age busy, like, grab their attention and then have fun." eg, videos, songs, cartoon animation movies) as well as informative. Information addressing a variety of issues specific to their daily lives and practical problem-solving techniques dealing with particular situations (eg, sports participation, peer pressure, and risky behaviors) was considered desirable, as opposed to information that one participant described as, "just so general, you're just getting barely anything." Older participants were particularly interested in tips and strategies to manage their asthma. In weighing information from currently available Web sites, participants were concerned a great deal about trustworthiness and legitimacy of the source and preferred those sites offered by health professionals affiliated with a reputable health-care institution (eg, university health system). They agreed that if the Web site was referred to them by a reliable person (eg, health-care provider, school teacher, or a trusted other), they would be more likely to use it.

In general, participants in all groups expressed high levels of concern about participation in online chat rooms or instant messaging intended to provide a virtual community of support. In our group discussion, neither teens nor facilitators referred to a specific type of chat room as either text-based or audio-based. Only a few participants endorsed the possible benefits of unspecified chat rooms as a route to meet with peers with the same illness to make friends and share their experiences. Overall, participants were not comfortable with chat rooms or expressed intim-

idation about using chat rooms, because of safety and security concerns, regardless of whether the chat room is text based (using instant messaging technology) or audio-based (using the voice-over-Internet protocol). They cited teachers, parents, friends, and media reports as sources of their heightened awareness of the possible dangers of chat rooms. Those who had previously participated in various chat rooms described negative experiences with rude people or exposure to negative elements, such as pornography, while there. According to the participants, chat rooms have evolved into "play rooms" and are not an optimal tool for information seeking.

When probed further, some participants reported the possibility of visiting a message board or joining a private online room to discuss asthma if they knew all the persons in the room. Others stated that they would use chat rooms if they knew the conversation was monitored by knowledgeable personnel so the discussion would remain on topic and the adequacy and accuracy of information exchanged could be assured. A member of the younger boys group suggested a chat room where he could directly communicate with health-care providers. Despite defining features that would make chat room technology appropriate for asthma information and support, it was not clear that any of the participants would be interested enough to overcome their initial concerns regarding chat room participation.

Discussion

Literature has been limited in describing adolescents' learning experiences related to asthma and detailing their particular learning needs. Moreover, differences in learning needs between younger and older adolescents with asthma—despite their developmental distinctiveness—have not been explored. In acknowledging these shortcomings in the literature, the present study attempted to examine similarities and differences between younger (12–15 y) and older (16–18 y) adolescents in their learning needs regarding asthma. Compared to the older adolescents, the younger adolescents were more interested in learning about their illness and actively engaged in seeking information through reading, asking experts, and talking with friends. Such differences may be, in part, due to their perceptions about their own knowledge about asthma. Older participants tended to assume an attitude of self-proclaimed expertise on asthma, because most of them had dealt with the illness since they were little. Because measuring the knowledge level of adolescents was not the focus of this study, we cannot conclude if such attitudes were an accurate reflection of their knowledge. On the other hand, younger participants' greater interest in asthma learning opportunities and asthma information may have been a reflection of intellectual curiosity blossoming in early adolescence with developing capacity for formal operational thinking.[14] In addition, younger participants may have perceived strong learning needs because of increasing self-awareness of autonomy and responsibility transferred from parents in managing their own illness as they move from childhood to early adolescence.[26] Whatever the underlying reasons may be for such differences, this finding underscores the importance of capturing the critical period that may occur between 12 and 15 years of age, to optimize asthma education. Younger adolescents' high motivation for learning about asthma can maximize the effectiveness of asthma education when such opportunities are made available.

Participants were selective about where they obtained asthma information. Credibility and dependability of information sources emerged as an important factor in the participants' motivation for learning about asthma. Participants indicated health-care providers as the most legitimate source of information, although their chances to obtain information from those individuals had been limited. In general, health-care providers, including school nurses, suffer time constraints that decrease the likelihood of their assisting adolescents in asthma learning. Nonetheless, adolescents' reliance on health-care providers for asthma information requires that providers be proficient and efficient in addressing adolescents' asthma learning needs. Therefore, it is of paramount importance that providers have up-to-date management options and the time necessary to communicate the information. Kyngas and Rissanen[27] noted that adolescents tended to recognize continuous encouragement and positive feedback from health-care providers as one of the most important factors influencing their self-management behaviors of their chronic illnesses. Given the indispensable role of health-care providers perceived by adolescents, enhancing providers' competency and confidence in meeting adolescents' needs for information and support is imperative.

The ability to openly discuss illness with others is associated with asthma self-management in adolescents.[28] Therefore, it is worrisome that our participants, because of their concern about peoples' overreaction to or underestimation of their asthma, were reluctant to discuss their asthma with others who did not have asthma. Nonetheless, most participants were generally comfortable talking with peers with asthma about their illness and expressed positive attitudes and enthusiasm about the idea of sharing experiences and information with those peers. Both younger and older participants sought information and support from those peers. This finding echoes previous reports that adolescents with chronic conditions highly regard support from peers with the same health situation, because of greater ease in conversing about illness and perceived genuine understanding and care from those peers.[29] Studies have shown that interactions among adolescents who have

asthma can make them aware that others have the same illness, instilling a sense of support and normalcy[30,31] and relieving feelings of isolation and compromised peer identification due to limited participation in physical activities with healthy peers.[32] The finding that the participants valued information from peers who had successfully managed their asthma highlights the potential application of programs to promote active participation of adolescents with asthma, who can serve as role models and educators for their peers.[5] Given the beneficial effects of peer interactions in adolescence, providing a context in which adolescents with asthma can interact with and obtain support from each other should be a priority in asthma programs that target this population.

The Internet may be an avenue for providing services to adolescents with asthma. Numerous asthma Web sites exist, but not all sites offer accurate and reliable information. Participants in this study rightfully raised concern over the credibility of Internet asthma information. However, participants stated that they would be comfortable using Web sites that were recommended by their health-care providers, teachers, or peers with asthma. Therefore, for health-care providers to encourage adolescents in the use of Web sites for asthma education, the providers must be familiar with asthma Web sites and determine the quality of Web sites before referring adolescents to particular Web sites. The standard for identifying reliable health information on the Internet is the Health On the Net Foundation's principles for evaluating health-information Web sites (http://www.hon.ch/honcode/conduct.html).[33]

Some participants reported sporadic use of and eventual loss of interest in asthma Web sites, because the sites were designed for either younger children or adults. Participants in this study suggested various ways to make the Web sites teen-friendly, by adding entertaining features such as animation, cartoon characters, videos, and lyrics, albeit such features increase the complexity of developing and maintaining a Web page, requiring expert graphics designers, programmers, and frequent updates. Currently available Web sites also predominantly focus on the pathophysiology of asthma and the medical management of asthma rather than providing practical information on how to maintain normalcy as adolescents on an everyday basis without jeopardizing their health. In addition to practical information about self-management skills, such as correct inhaler use and breathing technique, some participants were interested in obtaining information useful in dealing with developmental challenges pertinent to adolescence (eg, peer pressure). Taken together, the participants' suggestions indicate that an asthma Web site for adolescents needs to include developmentally specific and practical content in an entertaining format to stimulate and sustain adolescents' interest.

Peers are an essential component of social support among adolescents.[34] Adolescents often look to their peers for benchmarks of normalcy[35] and strive to obtain peer approval by conforming to peer-defined attitudes, values, and behaviors. Therefore, one of the most important developmental needs of adolescence is to establish social networks through peer relationships. Peer networks are of particular importance for adolescents with chronic health conditions, because they deal with both developmental tasks and disease-related challenges.[6,36,37] Therefore, it is not surprising that adolescents with asthma have a particular interest in developing peer support groups.[38] In creating and maintaining a social network, online communication is widely used by adolescents. In a study that offered a Web-based support system for adolescents with cystic fibrosis, the participants most frequently used a Web feature for socializing with other participants.[39] Researchers and clinicians have used online support groups for adolescents with chronic diseases, including asthma.[39–42]

In line with those earlier findings, we explored the possibility of using online communication tools to facilitate a peer social network among adolescents with asthma. Of various online communication possibilities, we focused on the participants' use of chat rooms. Only a small fraction of the participants admitted to prior use of online private text-based chat rooms or peer-to-peer instant messaging to communicate with friends. Most were reluctant to continue participating in chat rooms, because of prior experience, or denied past experience with chat rooms. Although participants acknowledged the usefulness of chat rooms for connecting with other peers to create a virtual community, the idea of chat rooms was received with much reservation because of safety and privacy concerns. Instead of chat rooms, a few participants suggested using message boards, which could be monitored by a health expert, as a way of ensuring safety and adequacy of information while allowing for feedback. The feasibility of this monitoring mechanism needs to be tested in future research.

Participants alluded to the possibility of using Web sites for communicating with health-care providers to report asthma conditions and receive immediate feedback. In a study in Denmark, an Internet-based asthma monitoring program that provided a communication loop between asthma patients and health-care providers was developed and tested with adults, and its trustworthiness was well accepted by both parties.[43] Further research is warranted to explore the feasibility, efficacy, and cost-effectiveness of an Internet program that would allow adolescents to transmit information about their asthma conditions (eg, peak flow values, symptoms, and medication use) to health-care providers and, in return, receive tailored plans based on the reported conditions.

The generalizability of our findings is limited by the small sample size. However, in qualitative research such as this study, in-depth understanding of phenomena is prioritized over generalizability. As in other studies that have relied on volunteer participants, the findings may have been subject to a self-selection bias. Data derived from group settings also have some inherent limitations, as dominant group members may control the discussion so that not all voices are equally heard. Also, the results may be limited by *social desirability bias*, which occurs when a participant provides answers that he or she believes are expected or desired by the researchers or by other participants. For instance, adolescents may have under-reported their participation in activities they have been warned against, such as chat rooms, and over-reported participation in activities they perceived more positively. Participants, however, did not appear to refrain from disagreeing with one another or criticizing particular elements of their home or school environments. Therefore, we think it was unlikely that social desirability bias strongly influenced participants' responses. Despite several limitations of the focus group method, the study results provide important insights into advancing existing understanding about issues in adolescents' asthma learning needs and on using information technology as an educational tool for adolescents.

Providing an opportunity for continuing education has been found to be effective in enhancing knowledge, positive attitudes, and self-efficacy in the long-term.[44] The Internet, through resources and online communication tools, can promote continuing asthma self-management in adolescents by providing opportunities for reviewing and updating their asthma information, and by facilitating feedback and support from health-care providers and other adolescents with asthma. Ongoing feedback on self-management behaviors and peer support are important for reinforcing and affirming positive behaviors. In current practice environments, providing continuous follow-up and communication in person is not always feasible because of time and financial constraints on both patients and providers. As an alternative, information technology may be a powerful option for providers and adolescents with asthma in enabling ongoing asthma education and keeping the communication channel open among participating personnel. While the goal of this study was not to determine the best practice for Internet-based resources and methods of online interactive communication, the participating teens suggested ways to improve Internet asthma information and promote virtual communities among teens who have asthma. Our findings offer a variety of ideas to consider for future research that incorporates current Internet tools to deliver asthma information.

Conclusions

Early asthma education is needed to capitalize on younger adolescents' greater interest in learning about asthma. Asthma education for adolescents must be designed by taking into consideration their cognitive development and psychosocial characteristics, such as peer dynamics. Use of the Internet can be effective in addressing learning needs in adolescents with asthma, given the Internet's accessibility, sustainability, and versatility. An Internet-based asthma program specifically designed for adolescents can provide asthma-related information and also address psychosocial needs through communication features that facilitate interactions with their peers with asthma. In doing so, health-care providers' careful, ongoing monitoring and evaluation of the program is required to ensure safety and adequacy of information.

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