

Innovations in Technology: Social Media and Mobile Technology in the Care of Adolescents with Asthma

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Abstract This literature review analyzed technological interventions in the adolescent asthmatic population. A PubMed search was performed with terms of asthma, adolescents, social media, Internet, website, mobile phone, text messaging, SMS, Facebook, Twitter, MySpace, and Technology during a 2.5-year period and identified 64 abstracts. Three studies fulfilled the criteria for adolescent intervention using Internet-based sites but did not provide evidence for effectiveness. Two studies focused on mobile technology. One study included text message reminders for controller medication use in asthma patients. Perceived usefulness, satisfaction, and ease of use of text messages were high, but there was no improvement in asthma control. The literature search did not find any studies exploring the use of smartphone applications or social media services. Current studies of technology use in adolescents with asthma do not provide consistent evidence of effectiveness. The positive attitude toward use of social media or mobile technology opens the possibility for future studies to further explore the potential benefits of such interventions.

Keywords Adolescents · Asthma · Social media · Mobile technology · Internet · Websites · Smartphone · Text messaging · Risks

Introduction

Adolescent patients with asthma present clinicians with numerous challenges. The burden of asthma falls disproportionately on children and adolescents [1]. In 2009, the asthma prevalence rate in the United States was 9.6 % for children below the age of 17 [2]. Adolescence is a challenging life stage for those with chronic medical conditions. During this time, adolescents are developing self-regulatory behavior and organizational skills [3]. These skills are crucial for proper adherence to medications. A recent study in children and adolescents showed that adherence to inhaled corticosteroids (measured by canister weight or dose meter) is approximately 50 % [4]. Beyond the challenges of normal development, adolescents with asthma report higher levels of social anxiety than their non-asthmatic peers [5]. The unique aspects of adolescent development, combined with the physical and psychological burdens of asthma, prompt care providers to innovate to meet the needs of this population.

Technological innovations continue to change patient care in all areas of medicine. Societal trends of Internet use and mobile technology make these innovations a potentially powerful avenue to improve adolescent asthma care. As of 2008, 93 % of adolescents (aged 12–17) go online, and 80 % have a broadband connection within their home [6]. Mobile technology is now pervasive throughout our society. This article is meant to be a focused literature update of the current evidence for or against technological interventions in the adolescent asthmatic population. These interventions are conceptually

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divided into Internet-based interventions (social media and website-based) and mobile technology interventions.

Methods

A PubMed search was conducted for abstracts published between 1 January 2010 and 30 June 2012. The following search terms were used: asthma, adolescents, social media, Internet, website, mobile phone, text messaging, SMS, Facebook, Twitter, Myspace, and Technology. The major inclusion criterion was a study population containing patients aged 12–17 years. All studies not focused on using social media, Internet-based interventions, and mobile devices (applications or texting) were excluded. The results are reported in the specific sections below.

Internet-Based Interventions

Social Media

Social media is a rapidly growing phenomenon. Based on parental reporting, 75 % of adolescent Internet users in 2011 aged 12–17 used social media sites such as Facebook and Twitter, up from 49 % in 2006 [7]. According to data from a 2007 survey of adults, younger age was independently associated with increasing likelihood of social media use [8]. Social media permeate the medical literature. A PubMed search for the MeSH term ‘social media’ with publication dates from the 1 January 2005 to 31 December 2009 did not find any articles. The same search from 1 January 2010 through 31 May 2012 found 204 results. The majority of these articles are commentaries or reports on social media’s potential in health care, guides for professional use, and updates on professional publications/societies using social media. When the search was restricted to clinical trials, only one citation fit that description [9]. The study randomized adolescents to view fabricated Facebook pages with and without alcohol use posted and then used validated surveys to gauge willingness to use alcohol. Up to the date of this publication, no social media intervention for adolescents with asthma has been identified.

While no intervention has been published, there is emerging literature exploring the preference of adolescents with asthma in regard to the use of social media and other technologies. The University of Michigan researchers Baptist et al. recently published a study that characterized the social media, text message, and email preferences of asthmatic patients [10•]. The study included subgroup analysis of adolescents aged 12–17. It is important to understand the baseline demographic of those surveyed in order to assess applicability. The race/ethnicity of the study population was

white 70.8 %, Black 20.1 %, Asian 4.1 %, Hispanic 1.4 %, and other 3.1 %. Sixty percent of those surveyed were female. Approximately 77 % had had asthma for more than 5 years, and 77 % used daily controller medication. Of the 145 surveyed, 37.9 % were adolescents (ages 12–17).

While this study is limited by sample size and population bias, it is worth taking into consideration as we approach potential social media interventions. Fifty-nine percent of adolescents reported that they used Facebook at least once per week, 24 % use MySpace, and 12.8 % use Twitter. When asked to gauge their interest in receiving information through various electronic media, only 26.9 % reported some or high interest via Facebook, 6 % via Twitter, and 7.7 % via MySpace. When asked if they were interested in receiving communications through electronic media, 28.8 % reported some or high interest via Facebook, 7.8 % via MySpace, and only 2 % via Twitter. Weekly use of Facebook was a characteristic that predicated interest in receiving information (OR=11.2 %) and communicating with a doctor (OR=40.7) via Facebook.

This study begins to set the framework for an aspect of clinical care that has yet to be articulated. From a population standpoint, the large majority of adolescents are engaged with social media, and this percentage has grown substantially in recent years. Despite the rapid growth in use, the data currently available from the adolescent asthma population do not support widespread interest in incorporating social media into asthma care.

Website-Based Interventions

With over 80 % of adolescents ages 12–17 having high-speed access in their homes, accessing health information from online resources is becoming increasingly prevalent [7]. Over the past decade, the Internet has become an important tool for teens to search for sensitive, health-related information [11–13]. A recent survey of teenagers with asthma or diabetes showed that patients with asthma were more likely to participate in the study related to an online search for health information [14]. There was no significant relationship between health literacy and using the Internet for health information, which is contrary to the findings in the adult population [14]. The same cohort was analyzed to evaluate potential reasons why they did or did not use the Internet to search for health-related data [15]. Overall, 60 % of teenagers with a chronic illness visited at least one health related website during the study period. While not statistically significant, black teenagers, females, asthmatics, and regular Internet users trended toward higher use of the Internet for health-related conditions. Eighty percent of the teenagers that visited a health-related site reported they intended to return at least once in 6 months. These two

studies of preference and use patterns included teenagers recruited from specialty clinics and relied on self-reporting. Despite these limitations, these data support the assertion that teenagers with asthma are using the Internet for health information and those who are online are likely to continue to rely on the medium for future information.

Three abstracts fulfilled the search criteria for adolescent interventions using Internet-based sites [16•, 17••, 18•]. These studies were not homogeneous, and they had different interventions, outcome measures, and populations. Studies of web-based interventions on the adult population, while outside of the scope of this review, suggest that such interventions are feasible, safe, and acceptable to patients [19, 20]. The impact of web-based interventions on clinical outcomes in the population is unclear.

The first study that fulfilled the search criteria used an online peer-mentoring website, Ability Online, to host weekly chat sessions aimed at providing informational, affirmation, and emotional support [16•]. The outcomes for this study focused not on clinical improvement, but improved psychological parameters. Participants aged between 11–16 years were recruited out of various sites including a pediatric clinic, an asthma and allergy camp, and several websites. Using validated questionnaires, participants' support-seeking coping skills, feelings of support satisfaction, subjective measurements of social support network size, loneliness and self isolation, and feelings of self-efficacy were measured. Overall, 28 participants underwent the intervention and completed some or all of the post-intervention questionnaires. Based on this intervention, there was no statistically significant difference between pre- and post-intervention scores on questionnaires evaluating self-coping skills, perceived social support, network size, or self-efficacy. There was a statistically significant decrease in the loneliness and social dissatisfaction scale in the intervention group. This pilot study was limited by the small sample size and the lack of clinical parameters (either at baseline or in outcomes).

The second study had a more traditional design focused on disease-specific clinical outcomes [17••]. Adolescents aged 12–18 years from a large hospital system database in the Netherlands with the diagnosis of mild to severe persistent asthma were recruited to undergo usual care versus participating in an Internet-based self-management algorithm that would adjust medication based on reported Asthma Control Questionnaire (ACQ) scores. Only patients with asthma that was not well controlled were included in the study (based on elevated ACQ or ATAQ, Asthma Therapy Assessment Questionnaire). The usual care group visited their care provider (both primary care and subspecialty patient included) based on the standard of care (every 3–6 months) and as needed. The intervention group was asked to record their ACQ and FEV1 results weekly. They

received instant feedback according to a predefined algorithm that would step up or step down based on their reported ACQ. Outcomes were measured at 3 and 12 months in each arm. The primary outcome was asthma-related quality of life as measured by the Pediatric Asthma Quality of Life Questionnaire (PAQLQ). Secondary endpoints were asthma control (ACQ), number of symptom-free days, pre-bronchodilator FEV1, daily ICS dose, and exacerbations. The outcomes of this study prevent equal efficacy. Both groups improved their quality of life (as measured by the PAQLQ) with statistical equality at 12 months. A similar pattern was seen in the secondary outcomes, with ACQ and FEV1 results both being significantly improved in the intervention group at 3 months but equalizing at 12 months. The inhaled corticosteroids (ICS) usage and exacerbation rate did not differ between the study arms. As with other studies, the significance was limited by the relatively small sample size but also by the inclusion criteria of 'not well controlled' asthma. It is interesting to note that during the recruitment portion of this study, males were overrepresented in the population who chose not to participate after being invited (65 % vs. 47 %).

The final study that fulfilled the inclusion criteria was a follow-up subgroup analysis of a previously published randomized trial that involved African-American high school students and compared a "tailored" website versus a generic asthma website [21]. This study focused on a homogenous population of urban Detroit youth. Those who received a "tailored" website were presented with education adjusted specifically to the provided baseline information and given feedback based on their responses. The control group was provided with education from a generic website. At 12 months, the intervention group had statistically significant improvement in symptom-free days (primary outcome), night symptoms, school days missed, restricted activity days, and hospitalizations. Joseph et al. published a follow-up subgroup analysis of differences between participants who joined their web-based study "early" (during initial enrollment) and late (during a secondary enrollment period) as well as eligible non-participants [18•]. The sample size was 386, 36, and 1,246, respectively. This type of analysis is helpful as it aids in assessing bias and applicability, as well as clarifying future recruitment strategies. Younger age (OR=0.86 for each year increase in age), physician diagnosis of asthma (versus simply symptom-based inclusion), and medication use were all predictors of participation. Late participants were more likely to be male and were also less likely to be compliant with the study follow-up.

These three studies do not provide evidence that website-based programs for asthma education or management are effective interventions in the adolescent population. As with previous reviews of technological innovations for asthma

management, these studies do not provide generalizability or the consistency in interventions to draw evidence-based conclusions [22]. There does seem to be a pattern emerging in regard to gender preferences. There were two examples of males being over represented in the non-participant population or the late adopters [17•, 18•]. Gender affects adolescent behavior in terms of incorporating chronic disease into their self-identities [23]. Returning to Baptist et al.'s study on the asthmatic patients' social media, text messaging, and email preferences, among frequent Facebook users, female gender significantly predicted desire to be contacted by their doctor via Facebook [10•]. These observations are inconclusive, but suggest that certain populations may benefit more or less from the application of technologic innovations. This is in contrast to previous interventions such as the Asthma Action Plan, which is intended to be provided to all asthmatic patients.

Mobile Technology

Mobile technology use is rapidly growing among the adolescent population. According to data collected by the Pew Internet and American Life Project 2011 report, 77 % of those aged 12-17 report having cell phones [24]. In the same group, the median number of text messages sent on a typical day in 2011 was 60. This has increased from 50 in 2009. Text messaging is the most commonly used media for communicating with people in the lives of teens, with 63 % reporting using text messages daily compared to 29 % reporting using social media messaging, 22 % using instant messaging, and 39 % using cell phones for voice communication.

Text Messaging

Recent literature suggests that using text messaging to improve medication adherence is an acceptable and cost-effective intervention [25–28]. A recent randomized controlled trial aimed at increasing influenza vaccination rates among children and adolescents in a low-income urban population showed that weekly text messages to parents with educational information and instructions statistically significantly improved vaccination rates in the intervention group [26]. Another randomized controlled trial that tested the effects of daily text messaging reminders to use sunscreen resulted in an over 20 % increase in adherence to sunscreen use over a 6-week period [25]. These are just two examples among many studies outside the scope of this article that make the case that text messaging interventions, evaluated by high-quality randomized controlled trials, improve medication adherence rates. However, recent studies

focused on asthma patients of all ages have conflicting results with regard to improved adherence and symptoms. Several studies have shown that text messaging improves adherence and the perceived necessity of the participant's preventive medication [28–30]. Similar studies have shown the contrary finding and have called into question the cost effectiveness of mobile technology-based asthma care [31, 32]. A detailed analysis of each of these studies is beyond the scope of this review.

Two studies were identified that directly evaluated a text messaging intervention involving the adolescent asthmatic population. Britto et al. conducted a feasibility study using text message reminders for controller medication [33•]. This study used an innovative intervention, allowing patients to create and schedule their own reminders via a web-based calendar-to-text system. The primary outcome of this study was the feasibility, acceptability, and utility of the text messaging system. The perceived usefulness, acceptability, satisfaction, and ease of use were high both initially and at 3-month follow-up. The secondary outcome of asthma control did not show any statistical significance, but this was expected because of the small sample size of this pilot study. Medication adherence was not measured in the study. Overall, this study further established the acceptability of text messaging interventions and the adolescent satisfaction with them. Allowing teenagers to control the timing and nature of the messages is an innovative approach and may aid adolescents in transitioning to more autonomous control of their medication use.

The second study involved adolescents (aged 12-18) with moderate or severe persistent asthma. A text messaging intervention that provided the teenagers with the ability to determine the content and timing of text messages was used to improve adherence to medication [34•]. This pilot randomized control trial provided extensive advanced motivational interviewing, problem-solving skill problems, and cell phones to both the control group ($n=9$) and the intervention group ($n=12$). The intervention group received 1 month of tailored text messages of three types. The first type of text messages was "messages from you to yourself," such as "Take your meds and go exercise" and "Remember to have your inhaler with you at all times." The second type of text messages were motivational messages, such as "Keep up the good work" and "Don't quit, you can do it." Finally, the participants were sent a text message weekly that prompted a return message if their asthma was not controlled that read: "Doing OK with your asthma? If not, call..." The message was associated with a number that was staffed by a specialized asthma nurse. This pilot study was designed to assess the feasibility and acceptability of the intervention. According to the authors, the teenagers were uniformly enthusiastic about the intervention and particularly liked the idea that they would be able to tailor the

messages to themselves. The published data on this pilot study do not include the frequency of text messages in the intervention group. With regard to outcomes, there was no statistical difference between the control and intervention group in standardized measures of patient activity, motivation, intentions, or perceived barriers to adherence. While this study's n value was low, the intervention group had a statically significant improvement in asthma symptoms at 1 month. This effect was also seen at the 3-month follow-up, which was 2 months after the end of the intervention.

Smartphone Applications

Mobile “apps” are software programs designed to run on handheld devices, typically smartphones. In July 2011, 82.2 million people owned a smartphone, which was up 54 % from the previous year. Among the teenage population, 5.6 million teens (aged 13–17) owned a smartphone [24]. Similar to the general population, this is up 53 % from the year prior. Based on our search criteria, no study has specifically evaluated mobile “apps” as an intervention to improve asthma education or clinical outcomes. Mosnaim et al. published a recent review article that included studies that utilized novel Internet and mobile technology to improve asthma education or clinical outcomes [35•]. Based on their review through October 2011, there were 13 available “apps” in iTunes and 5 Android-based “apps” that were promoted to improve asthma care. These applications ranged in price from free [8] to \$4.99. The features included the ability to journal or track symptoms’ peak flow and/or medication use. Asthma-related news was also available within some “apps.”

Risk Associated With Applying Novel Technology

Social media have some inherent risks and limitations. In the above study, almost 12 % of those surveyed did not want to use social media for health-related information [10••]. Others commented that they did not want their health information seen by friends. While social media provide new opportunities for adolescents to improve socialization skills, creativity, and expression, they also introduce new risks [36••]. Cyber bullying is a growing phenomenon in the social media world and has been linked to social anxiety and depression [37]. Researchers have recently introduced the concept of “Facebook depression,” where teenagers develop symptoms of depression after spending significant amounts of time using social media [38, 39].

Conclusions

Current studies of technology use in adolescents with asthma do not provide consistent evidence of its effectiveness. Most studies included a small number of subjects and had mixed results. Patients like the use of technology, but the majority still prefers face-to-face communication with their healthcare providers. Many vendors of electronic health records now offer patient-centric portals that provide opportunity for patient-physician interaction and education. The positive attitude toward the use of social media or mobile technology by adolescents opens the possibility for future studies to further explore the potential benefits of such interventions.

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